Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 1, 2, 15, 90 and 95 of the	)	ET Docket No. 15-26
Commission's Rules to Permit Radar Services	)	
in the 76-81 GHz Band	)	

REPORT AND ORDER

Adopted: July 13, 2017 **Released: July 14, 2017**

By the Commission: Chairman Pai and Commissioners Clyburn and O'Rielly issuing separate statements.

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Heading Paragraph #

I. INTRODUCTION

1. In this *Report and Order*, we establish a flexible and streamlined regulatory framework for radar applications that will operate within the 76-81 GHz band.[1] Specifically, we give vehicular radars and certain airport-based radars protection from harmful interference as well as a contiguous five gigahertz allocation, facilitating the development and deployment of new safety devices. Doing so also harmonizes our rules with international efforts to create a global allocation for vehicular radars, while promoting efficient use of spectrum by consolidating such radars into a single band. In addition, we establish a comprehensive and consistent set of rules and policies to govern the operation of vehicular radars and certain airport-based radars in the 76-81 GHz band. Collectively, these actions will encourage development of new and innovative radar applications that can provide important public benefits, while also ensuring that the authorized radar operations can coexist with one another and incumbent uses.

II. BACKGROUND

2. Radar operations involve the transmission of radiofrequency (RF) signals and analysis of the reflections from objects or people to determine their speed, range, and direction.[2] Information regarding the speed, range, and direction of nearby objects can facilitate a host of applications that are beneficial to the public. The *NPRM* that initiated this proceeding discussed the radar applications that have been deployed in the band – including vehicular radar applications that can prevent or lessen the severity of a significant number of traffic accidents, saving lives and reducing damage to property.[3]

3. Vehicular radars can determine the distance and relative speed of objects in front of, beside, or behind a vehicle to improve the driver's ability to perceive objects under poor visibility conditions or objects in blind spots.[4] Long-range vehicular radars (LRRs) use up to one gigahertz of bandwidth and typically provide a spatial resolution on the order of 0.5 meters.[5] Such radars have been deployed pursuant to a 1995 Commission decision to make the 76-77 GHz band available for vehicular radar systems on an unlicensed basis (i.e., under Part 15 of the Commission's rules).[6] Subsequently, the

[1] The 76-81 GHz band is part of the "millimeter-wave" spectrum. The term "millimeter-wave" derives from the wavelength of radio signals on frequencies between 30 GHz and 300 GHz, which ranges between 10 and 1 millimeters.

[2] *See* 47 CFR § 2.1(c) (radar is "[a] radiodetermination system based on the comparison of reference signals with radio signals reflected, or retransmitted, from the position to be determined."); ITU Radio Regulations 1.100-.102 (2012).

[3] *Amendment of Parts 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band*, ET Docket No. 15-26, Notice of Proposed Rulemaking and Reconsideration Order, 30 FCC Rcd 1625 (2015) (*NPRM*).

[4] The rules already give support for classifying a broad range of uses as "vehicles." *See* 47 C.F.R. §§ 15.252(a) and 15.515(a). *Cf.* § 15.245(b)(1)(iii). We intend to continue to apply our rules broadly and will rely on existing processes that provide interpretations of the rules in response to specific requests. For example, the Office of Engineering and Technology's Laboratory Division has developed a substantial body of supplemental guidance through the online Knowledge Database (KDB). KDB publication 653005, recently published for comment, addresses what types of vehicles may qualify under the Part 15 vehicular radar rules (*see* 653005 Interpretation of Section 15.253(c) DR01-42888, available at https://apps.fcc.gov/eas/comments/GetPublishedDocument.html?id=426&tn=409139 (Draft for Review)).

[5] Robert Bosch, LLC Comments at 8 n.15, 9 (Bosch Comments); *NPRM*, 30 FCC Rcd at 1627, para. 8.

[6] *See Amendment of Parts 2, 15, and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications*, ET Docket No. 94-124, First Report and Order and Second Notice of Proposed Rulemaking, 11 FCC Rcd 4481, 4488-89, paras. 15-17 (1995); 47 CFR § 15.253. An unlicensed radar operates under the conditions that the device may not cause any harmful interference and that interference caused by the operation of an authorized radio station, by industrial, scientific and medical equipment, by another intentional or unintentional radiator, or by an incidental radiator must be accepted. 47 CFR § 15.5(b).

2012 Radar R&O modified the Part 15 rules to allow greater technical flexibility for unlicensed vehicular radar applications in the 76-77 GHz band.[7] Under the existing rules, we have witnessed the development of an impressive host of LRR-related vehicle safety features, including collision avoidance and adaptive cruise control systems. The vehicular radar industry also has developed short-range vehicular radars (SRRs) that support such applications as blind spot detection, lane-change assist, and the detection of pedestrians and bicycles. Such radars provide higher resolution than LRRs and, because they are especially useful for detecting objects in close proximity of a vehicle, benefit many types of passive and active safety applications.[8] However, to provide this higher spatial resolution, SRRs require an operating bandwidth of four gigahertz.[9] Because the Commission's rules currently authorize only the 76-77 GHz band for millimeter-wave vehicular radars operations based on one-gigahertz bandwidth LRR applications, the available spectrum is insufficient to support four-gigahertz bandwidth SRR applications.[10]

4. Several specialized radar applications also operate in the 76-77 GHz band. As part of the *2012 Radar R&O*, the Commission extended the unlicensed use of the 76-77 GHz band to fixed radars operating at airport locations under the same Part 15 rules and with the same emissions limits that it applied to vehicular radars in the band.[11] These fixed radars include radars that detect foreign object debris (FOD)[12] on airport runways (known as "FOD detection radars"), and radars that monitor aircraft and service vehicles on taxiways and other airport vehicle service areas that have no public access (e.g., gate areas).[13] The Commission, by limiting fixed radar systems to airport air operations areas,[14] enabled airport personnel to better monitor taxiways and improve debris detection on runways, while protecting vehicular radars from potential interference through geographic separation.[15] The Commission further

[7] *Amendment of Sections 15.35 and 15.253 of the Commission's Rules Regarding Operation of Radar Systems in the 76-77 GHz Band*; *Amendment of Section 15.253 of the Commission's Rules to Permit Fixed Use of Radar in the 76-77 GHz Band*, ET Docket Nos. 11-90 and 10-28, Report and Order, 27 FCC Rcd 7880, 7883-86, paras. 9-18 (2012), *erratum*, 27 FCC Rcd 8362 (OET 2012) (*2012 Radar R&O*).

[8] SRR applications that enhance passive safety include obstacle avoidance, collision warning, lane departure warning, lane change aids, blind spot detection, parking aids, and airbag arming. SRR applications that enhance active safety include "stop and follow," "stop and go," autonomous braking, firing of restraint systems, and pedestrian detection. *See, e.g.*, Petition of Robert Bosch LLC for Rulemaking for Amendment of Part 15 of the Commission's Rules to Permit the Operation of Vehicular Radar Systems in the 77-81 GHz Band, RM-11666, at 3-4 (filed May 15, 2012) (Bosch Petition).

[9] *NPRM*, 30 FCC Rcd at 1627, para. 8. *See also* International Telecommunication Union ITU-R M.2057-0 (02-2014) Systems characteristics of automotive radars operating in the frequency band 76-81 GHz for intelligent transportation systems applications at 5, https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2057-0-201402-I!!PDF-E.pdf (specifying a necessary bandwidth of four gigahertz for the operation of SRRs in the 76-81 GHz band). SRRs may already operate in the 77-81 GHz band in Europe. Bosch Comments at 7 n.11.

[10] *NPRM*, 30 FCC Rcd at 1627, para. 8. A July 5, 2017 examination of the Commission's equipment authorization database shows that several unlicensed wideband and UWB SRRs have been certified to operate in the 23.12-29 GHz and 22-29 GHz bands, and appear to support blind spot monitoring and side-looking radar applications.

[11] *2012 Radar R&O*, 27 FCC Rcd at 7887-89, paras. 19-26.

[12] Generally speaking, FOD includes any substance, debris, or object in a location that can damage aircraft or equipment.

[13] 47 CFR § 15.253(c).

[14] Air operations areas are "all airport areas where aircraft can operate, either under their own power or while in tow. The airport operations area includes runways, taxiways, apron areas, and all unpaved surfaces within the airport's perimeter fence. An apron area is a surface in the air operations area where aircraft park and are serviced (refueled, loaded with cargo, and/or boarded by passengers)." 47 CFR § 87.5.

[15] *2012 Radar R&O*, 27 FCC Rcd at 7888, para. 24. The Commission described the importance of the airport's ability to determine the location of airplanes and airport ground vehicles that are operating on taxiways and

(continued….)

addressed FOD detection radars in 2013, when it amended Part 90 to permit, in the 78-81 GHz band, the certification, licensing, and use of fixed and mobile FOD detection radar equipment in airport air operations areas.[16] The Commission, however, did not adopt technical specifications for these licensed FOD detection radars. Level probing radars (LPRs) also operate throughout the 75-85 GHz band, which includes the 76-81 GHz band segment.[17] These radars operate on an unlicensed basis, and are used to measure the amount of various materials contained in storage tanks or vessels or to measure water or other material levels in outdoor locations.[18]

5. Licensed radar applications operating in portions of the 76-81 GHz band do so under the Radiolocation Service (RLS) allocations in the U.S. Table of Frequency Allocations (U.S. Table).[19] The band also contains allocations for the Amateur and Amateur-Satellite radio services. Amateur radio operators have stated that this frequency range (which they identify as the "4 mm band") is well suited for experiments relating to short-range high-speed data communications.[20] Since 1998, access for the Amateur Service in the 76-77 GHz band segment has been suspended to ensure against potential interference to what were then newly developing vehicular radar systems in that band.[21] The band is further allocated to the Radio Astronomy Service (RAS) and the Space Research Service (SRS), limited to space-to-Earth operations. The RAS is a passive service consisting of large earth stations that receive radio waves of cosmic origin to better understand our universe.[22] Research in the above-50 GHz range supports studies of star formation, properties of interstellar medium, detection of extra-solar planets, and similar research. RAS installations typically have been sited in remote locations to minimize background radio noise as well as the risk of harmful interference from active services.[23] The SRS (space-to-Earth)

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runways, and even more significantly, the benefits of reducing FOD hazards that may damage aircraft or equipment, seriously threatening the safety of airport personnel and airline passengers, and negatively impacting airport operations and logistics. *Id*. at 7888, para. 25; *see also Amendment of the Commission's Rules to Permit Radiolocation Operations in the 78-81 GHz Band*, WT Docket No. 11-202, Report and Order, 28 FCC Rcd 10423, 10423, para. 2 (2013) (*78-81 GHz FOD Detection Radar R&O*). Because airport runways, taxiways, and other non-public areas at airports are generally not near public roads, FOD detection radars at airports are geographically separated from public roads, thereby not illuminating public roadways and further reducing the potential of harmful interference to vehicular radars. *See 2012 Radar R&O,* 27 FCC Rcd at 7888, paras. 24, 26.

[16] *78-81 GHz FOD Detection Radar R&O*, 28 FCC Rcd at 10427, para. 12. The Part 90 rules, which apply to Private Land Mobile Radio Services, require each user to operate in accordance with the provisions of its individual license.

[17] 47 CFR § 15.256. *See Amendment of Part 15 of the Commission's Rules To Establish Regulations for Level Probing Radars and Tank Level Probing Radars in the Frequency Bands 5.925-7.250 GHz, 24.05-29.00 GHz and 75-85 GHz*, ET Docket No. 10-23, Report and Order and Order, 29 FCC Rcd 761 (2014) (*LPR R&O*).

[18] *See* 47 CFR § 15.3(ii).

[19] 47 CFR § 2.106. Unlicensed devices do not operate pursuant to an allocation in the U.S. Table; instead, those devices are authorized to operate under the conditions set forth in Part 15 of the Commission's rules.

[20] *NPRM*, 30 FCC Rcd at 1631, para. 22 (citing *Amendment of Parts 2, 15, and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications*, ET Docket No. 94-124, Third Report and Order, 13 FCC Rcd 15074, 15076-15077, paras. 6-9 (1998)).

[21] *See* 47 CFR § 97.303(s); *Amendment of Parts 2, 15, and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications*, ET Docket No. 94-124, Third Report and Order, 13 FCC Rcd 15074, 15076, para. 8 (1998) (suspension); *Amendment of Part 2 of the Commission's Rules to Realign the 76-81 GHz band and the Frequency Range Above 95 GHz Consistent with International Allocation Changes*, ET Docket No. 03-102, Report and Order, 19 FCC Rcd 3212, 3218, para. 18 (2004) (maintaining the suspension).

[22] *See* 47 CFR § 2.1(c); ITU Radio Regulations 1.13 (2012).

[23] *NPRM*, 30 FCC Rcd at 1631, para. 21.

operations in the 76-81 GHz band are receive only on the Earth's surface and involve the reception of signals from spacecraft or other objects in space for scientific or technological research purposes.[24]

6. The *NPRM*, which proposed to authorize radar operations throughout the entire 76-81 GHz band, was informed by a petition for rulemaking filed by Robert Bosch, LLC (Bosch) that sought an expansion of the operation of vehicular radar systems from 76-77 GHz to the larger 76-81 GHz band.[25] In its petition, Bosch asserted that expanding the available spectrum for vehicular radar operations would allow the development and deployment of a broad range of SRR applications that would enhance the passive and active safety of all kinds of road users.[26] In its comments on Bosch's petition, Continental Automotive Systems (Continental) contended that a wider bandwidth of up to four gigahertz is needed for newer automotive radar deployments for better range separation, range accuracy, angular accuracy, and reliable object discrimination.[27] The *NPRM* also stated that expanding vehicular radar use to the entire 76-81 GHz band would support industry efforts to provide an internationally harmonized band capable of supporting both LRR and SRR operations.[28] The *NPRM* further proposed to consolidate all vehicular radar use into the 76-81 GHz band. Specifically, the Commission proposed to modify certain Part 15 rules to eliminate provisions for the certification and operation of unlicensed vehicular radar devices in the 46.7-46.9 GHz band and three segments in the 16-29 GHz range.[29]

7. The *NPRM* proposed to adopt a streamlined regulatory framework that could accommodate the commercial development and use of various radar technologies. In particular, the Commission proposed to modify the U.S. Table to provide a uniform RLS allocation across the entire 76-81 GHz band by adding a primary RLS allocation at 77.5-78 GHz.[30] The Commission also proposed to consolidate radar operations in the band under the Part 95 "licensed-by-rule" framework. This would shift vehicular and other permitted fixed radar uses away from the Part 15 unlicensed operating model where they have no interference protection status.[31] It would also consolidate under Part 95 the authorization of FOD detection radars, which now are authorized either on an unlicensed basis under Part 15 or an individually licensed basis under Part 90. Finally, the Commission discussed a wide variety of radar applications that might be provided, including LRR and SRR vehicular radar applications, ground-use aircraft-mounted radars that could help prevent aircraft wing collisions at airports, and other fixed

[24] *See* 47 CFR § 2.1(c); ITU Radio Regulations 1.55 (2012).

[25] *NPRM*, 30 FCC Rcd at 1627-28, paras. 9-10.

[26] Bosch Petition at 3-4; *see also* Bosch Comments at 8 & nn.14, 15.

[27] Continental Automotive Systems, ADAS Business Unit, Comments, RM-11666, at 3; *see also* Bosch Comments at 8 (stating that "79 GHz SRR vehicular radar sensors can and should use up to 4 gigahertz occupied bandwidths in order to permit good range separation and object discrimination").

[28] *NPRM*, 30 FCC Rcd at 1634, para. 32 (citing commenters).

[29] *Id.* at 1638, at paras. 43-44. Specifically, in addition to the 76-77 GHz band (47 CFR § 15.253), the Commission's rules provide for unlicensed vehicular radar use in the 46.7-46.9 GHz band for general vehicular radar systems (*id.*), the 16.2-17.7 GHz band for vehicle back-up assistance (47 CFR § 15.252), and two sets of rules for different types of radars in bands that almost completely overlap: the 23.12-29.0 GHz band for wideband vehicular radar operations (*id.*) and the 22-29 GHz band for ultra-wideband (UWB) vehicular radar operations (47 CFR § 15.515).

[30] *NPRM*, 30 FCC Rcd at 1637-38, para. 41.

[31] *Id.* at 1636-37, paras. 38-39. Part 95 rules apply to the Personal Radio Services and provide for a variety of personal communications, radio signaling, and business communications. "Licensed-by-rule" means that an authorized user can access the entire available spectrum without an individual station license document and is instead authorized to operate as long as the operations are in accordance with the applicable service rules. *See* 47 U.S.C. § 307(e). Thus, while all spectrum use is shared among users who meet the eligibility and technical qualifications and no one has exclusive rights to any portion of the spectrum, those users are collectively afforded interference protection *vis-à-vis* other services, based on the allocation status under which they operate.

infrastructure radars that have traditionally not been authorized in the band.[32] While the *NPRM* proposed rules to expand the types and frequency range of radar uses beyond what is available under our current rules, it also asked questions about compatibility issues between new and existing services and sought to adopt final rules that would ensure that both new and incumbent operations would be able to share use of the band.[33]

III. DISCUSSION

8. In this *Report and Order*, we modify Parts 1, 2, 15, 90, 95, and 97 of the Commission's rules to adopt the Commission's proposal to permit certain radar applications in the entire 76-81 GHz band, namely vehicular radars and fixed and mobile radars in airport air operations areas.[34] To accomplish this objective, we first address the appropriate changes to the U.S. Table. We also address the interference concerns raised by amateur and radio astronomy constituents, evaluate the compatibility of radar applications with those incumbent operations in the 76-81 GHz band, and modify the emissions limits for the amateur services to ensure that the potential for harmful interference to vehicular radar operations in the 76-81 GHz band is negligible.

9. Given the large amount of contiguous spectrum we are providing for radar use, we consolidate vehicular radars and other specific types of fixed and mobile radar operations into the 76-81 GHz band. First, we modify and eliminate certain Part 15 rules under which vehicular radar devices have been authorized on an unlicensed basis and transition those uses to the 76-81 GHz band; namely, we remove vehicular radar operations from the 16.2-17.7 GHz and 46.7-46.9 GHz bands and establish a gradual phasing out of wideband and ultra-wideband (UWB) vehicular radar operations in the 23.12-29.0 GHz band and the 22-29 GHz band, respectively.[35] Second, we will allow certain types of non-vehicular fixed and mobile radars to use the entire 76-81 GHz band only in airport operations areas, declining at this time to allow these types of radar operations outside of airport grounds. Finally, we consolidate the technical rules for the radar operations that will operate in the 76-81 GHz band, shifting those operations currently authorized under the Part 15 'unlicensed' model and the Part 90 'individually licensed' model to the Part 95 'licensed-by-rule' model.[36]

A. Allocation Changes to the 77.5-78 GHz Band

10. In the U.S. Table, the 76-77.5 GHz and 78-81 GHz bands currently are allocated to the RLS and the RAS on a primary basis, and to the Amateur Service on a secondary basis.[37] The Amateur-Satellite Service is secondary in the 77-77.5 GHz and 78-81 GHz bands, and the SRS (space-to-Earth) is secondary in the entire 76-81 GHz band. The 77.5-78 GHz segment is the only portion of the 76-81 GHz band that does not have an RLS allocation. It is allocated to the Amateur and Amateur-Satellite Services

[32] *NPRM*, 30 FCC Rcd at 1633-34, 1635-36, 1638-43, paras. 28-32, 35, 45-61.

[33] *Id.* at 1634-35, 1636, 1643-44, paras. 33-34, 36, 62-66.

[34] Specifically, we are modifying Sections 1.1307, 2.106, 2.1091, 2.1093, 15.37, 15.252, 15.253, 15.515, 90.103, 95.347, 97.303, and 97.313, and adding new Part 95, Subpart M, Sections 95.3301, 95.3303, 95.3305, 95.3331, 95.3333, 95.3347, 95.3361, 95.3367, 95.3379, and 95.3385, as shown in Appendix A to this *Report and Order*.

[35] The Commission's rules require that the transmissions from a UWB device occupy a minimum bandwidth of 500 megahertz, 47 CFR § 15.503(d), whereas wideband devices are limited to operation in a smaller frequency range that avoids the restricted bands set forth in 47 CFR § 15.205. *See Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, ET Docket No. 98-153, Second Report and Order and Second Memorandum Opinion and Order, 19 FCC Rcd 24558, 24577-78, paras. 38-39 (2004).

[36] This *Report & Order* does not apply to LPRs; LPRs will continue to be authorized to operate on an unlicensed basis (i.e., under Part 15 of the Commission's rules) in several different frequency ranges, including in the 75-85 GHz band. *See infra* note 184.

[37] 47 CFR § 2.106. A secondary service is not entitled to protection from any primary service. *See* 47 CFR § 2.105(c)(2)(ii).

on a primary basis and to the RAS and SRS (space-to-Earth) on a secondary basis. As a visual summary, this is the current status of the U.S. allocations in the 76-81 GHz band:[38]

Current U.S. Allocations in the 76-81 GHz Band
(Radio services printed in all capitals are primary services; services printed in normal characters are secondary services.)
(Not to scale. For illustration purposes only.)

<table>
<tr><td colspan="2">76-77.5 GHz
RADIOLOCATION</td><td></td><td>78-81 GHz
RADIOLOCATION</td></tr>
<tr><td>76-77 GHz
Amateur</td><td>77-77.5 GHz
Amateur
Amateur-satellite</td><td>77.5-78 GHz
AMATEUR
AMATEUR-SATELLITE</td><td>78-81 GHz
Amateur
Amateur-satellite</td></tr>
<tr><td colspan="2">76-77.5 GHz
RADIO ASTRONOMY</td><td>77.5-78 GHz
Radio astronomy</td><td>78-81 GHz
RADIO ASTRONOMY</td></tr>
<tr><td colspan="4">76-81 GHz
Space research (space-to-Earth)</td></tr>
</table>

1. Primary Status for the RLS Allocation at 77.5-78 GHz

11. To effectuate the goal of expanding the available spectrum for radar operations in the 76-81 GHz band, the Commission proposed to allocate the 77.5-78 GHz portion of the band to the RLS on a primary basis.[39] Doing so would make the entire 76-81 GHz band available for licensed radar applications on a primary basis. In addition, adopting this allocation would bring the U.S. Table in line with the decision in the International Telecommunication Union (ITU) 2015 World Radiocommunication Conference (WRC-15) that made the RLS primary in the 77.5-78 GHz band, thereby making the entire 76-81 GHz band available internationally for the RLS.[40]

12. The proposal received significant support and no commenter opposed the proposed allocation.[41] The Consumer Electronics Association (CEA)[42] states that the 76-81 GHz band is an excellent technical fit for vehicular radars, and modifying the U.S. Table will harmonize the deployment

[38] 47 CFR § 2.106.

[39] *See NPRM*, 30 FCC Rcd at 1637-38, para. 41.

[40] *See* ITU-R *Final Acts WRC-15 World Radiocommunication Conference Geneva, 2015* at 51 (entry into force on Jan. 1, 2017), http://www.itu.int/pub/R-ACT-WRC.12-2015/en (adding a primary RLS allocation, and footnote 5.559B, to the 77.5-78 GHz band in the International Table of Frequency Allocations). We update the International Table within 47 CFR § 2.106 to reflect Article V, Section IV, Table of Frequency Allocations, RR5-139 to RR5-140 of the ITU *Radio Regulations*, Edition of 2016. The International Table within 47 CFR § 2.106 is included for informational purposes only, 47 CFR § 2.104(a), and thus, the changes we make are non-substantive. *See, e.g.*, *Amendment of Parts 1, 2, 15, 25, 27, 74, 78, 80, 87, 90, 97, and 101 of the Commission's Rules Regarding Implementation of the Final Acts of the World Radiocommunication Conference (Geneva, 2007) (WRC-07), Other Allocation Issues, and Related Rule Updates et al.*, ET Docket No. 12-338 et al., Report and Order, Order, and Notice of Proposed Rulemaking, 30 FCC Rcd 4183, 4233-34, para. 141 (2015).

[41] *See, e.g.*, Consumer Electronics Association Reply at 2 (CEA Reply); Bosch Comments at 6; Automotive Safety Council Comments at 3 (ASC Comments); Letter from Ari Q. Fitzgerald, Counsel to Alliance of Automobile Manufacturers, to Marlene H. Dortch, Secretary, FCC (on behalf of Alliance of Automobile Manufacturers, General Motors, FCA US LLC, Association of Global Automakers, Mercedes Benz USA, and American Honda Motor Company), ET Docket No. 15-26, attached presentation at 2 (filed June 27, 2016) (Alliance June 2016 *Ex Parte*).

[42] In November 2016, CEA announced its name change to the Consumer Technology Association (CTA). We use "CEA" in this document for consistency with the record in this proceeding.

of these technologies with other countries' allocations, allowing seamless global advancement in safety technologies, eventually leading to autonomous vehicles.[43] The Automotive Group supports the proposed allocation because it is consistent with current international efforts to create a globally harmonized spectrum allocation for vehicular radar operations in the 76-81 GHz band.[44] The Automotive Group also states that such an allocation will allow vehicular radar suppliers and automobile manufacturers to take advantage of the economies of scale that result from spectrum harmonization, which will make life-saving devices less expensive and more widely deployed around the world.[45] We find these reasons persuasive and adopt the proposed primary RLS allocation in the 77.5-78 GHz band, thereby making the entire 76-81 GHz band available for licensed radar applications.

2. Secondary Status for the Amateur Service and Amateur-Satellite Service Allocations in the 77.5-78 GHz Band

13. As noted above, the 76-77.5 GHz and 78-81 GHz bands are allocated in the U.S. Table to the Amateur Service on a secondary basis, although access in the 76-77 GHz band has been suspended since 1998;[46] the 77-77.5 GHz and 78-81 GHz bands are allocated to the Amateur-Satellite Service on a secondary basis; and the 77.5-78 GHz band is allocated to both the Amateur and Amateur-Satellite Services on a primary basis. In the *NPRM*, the Commission revisited the issue of how to structure future amateur use of the 76-81 GHz band.[47] Specifically, the Commission proposed to adopt "a comprehensive approach for amateur radio use on these frequencies" and tentatively concluded that "there is no apparent technical reason to treat the 76-77 GHz and the 77-81 GHz bands differently."[48] In that regard, the Commission asked whether to "extend the 76-77 GHz amateur suspension to the entire 76-81 GHz band," and if so, whether to remove all amateur allocations from the 76-81 GHz band.[49] Alternatively, the Commission asked if it were possible "to lift [the] suspension of the amateur service and conduct both amateur and vehicular radar operations in the entire 76-81 GHz band."[50] In that regard, the Commission asked for comment on its proposals from "commenters [who] believe that amateur operators can continue to use the millimeter[-wave] band" as to "what additional rule modifications [the Commission] would have to adopt to realize successful shared use of the entire band," citing, for example, edits to the Part 97 Amateur Radio Service emissions limits rules.[51] Finally, the Commission sought comment on "other

[43] *See* CEA Reply at 2-6 (reiterating that "international harmonization is crucial to enabling the most efficient deployment of next generation technology"); *see also* Continental Automotive Systems, Inc. Comments at 1 (Continental Comments) (stating that the proposed expansion would be helpful in creating a globally harmonized spectrum allocation for vehicular radars in the 76-81 GHz band).

[44] The Former Strategic Automotive Radar Frequency Allocation Group, Caterpillar, Delphi Automotive, and General Motors Company Comments at 6-7 (Automotive Group Comments).

[45] *See id.* at 7; *see also* Telecommunications Industry Association Comments at 2 (encouraged that the Commission is moving in a similar direction as the European Commission (EC) and elsewhere in the world to open the 77-81 GHz band for vehicular radars); *see* ASC Comments at 2 (recommending that we harmonize with the global effort to utilize the 76-81 GHz band for vehicular radar applications, as this would facilitate more rapid implementation of active safety systems (i.e., faster time to market and broader availability), and reduce the cost impact to the consumer by building on technology and capability that is already being developed).

[46] *See supra* para. 5.

[47] *NPRM*, 30 FCC Rcd at 1643, para. 62.

[48] *Id.* at para. 63.

[49] *Id*.

[50] *Id*.

[51] *Id.* at 1644, para. 65.

approaches that would achieve compatibility between the amateur and radiolocation services within the 76-81 GHz band."[52]

14. The amateur community strongly rejects the idea of continuing the suspension of amateur operations in the 76-77 GHz band,[53] let alone eliminating amateur use of the entire 76-81 GHz band.[54] Amateurs claim they have been using the part of the band not subject to the suspension (i.e., 77-81 GHz) and remain interested in continued use of the entire 76-81 GHz band.[55] ARRL, the National Association for Amateur radio (formally known as the American Radio Relay League, Incorporated), and Bosch, an automotive components supplier, cite ITU Report ITU-R M.2322-0[56] in arguing that the amateur radio services and vehicular radars are compatible.[57] On the other hand, the Automotive Group is skeptical about the coexistence of amateur operations and vehicular radars. It points to the European regulators' decision to move amateur operations to the 75.5-76 GHz band because of the risk of interference to vehicular radars in the 76-81 GHz band, and contends that suspension of amateur operations in the entire 76-81 GHz band is warranted.[58]

15. Contrary to ARRL's and Bosch's assertions, the ITU-R Report only analyzed and concluded that vehicular radars will not cause interference to amateur and other incumbent operations in the 77.5-78 GHz band,[59] but did not evaluate whether amateur operations could potentially cause interference to vehicular radars. Nevertheless, we believe that amateur operations, under certain conditions as discussed below, can coexist with vehicular radar applications in the 76-81 GHz band. ARRL notes the difficulty, cost, and impracticality of developing high-power transmitters for amateur

[52] *Id*. at 1643, para. 63.

[53] *See* ARRL, the National Association for Amateur Radio Comments at 13 (ARRL Comments) (arguing that there is no basis for a finding to continue the current suspension of amateur use of the 76-77 GHz band); Gary Lauterbach Amateur Radio Operator AD6FP, Comments at 5 (Lauterbach Comments) (arguing that the suspension of amateur use of the 76-77 GHz segment should be lifted since available studies show coexistence to be practical); Robert M. Bownes III, Amateur Radio Operator KI2L, Comments at 1 (opposing any reallocation or restrictions placed on the amateur radio services in this spectrum allocation as well as expansion of commercial services into this spectrum); William Polewarczyk, Amateur Radio Operator WA1DMV, Comments at 1 (stating that the Amateur Radio allocations are a precious resource for continued experimentation and opposing the proposed use of the 4 mm band for vehicular radars).

[54] *See* ARRL Comments at 13 (arguing that there is no basis for a finding that the amateur allocations should be removed from the 76-81 GHz band); Lauterbach Comments at 5 (arguing that removing all amateur allocations from the 76-81 GHz band is contrary to the available interference studies); Michael Seguin, Amateur Radio Operator N1JEZ, Comments at 2 (hoping that amateurs are able to retain some portion of the 77 GHz spectrum to allow further experimentation in the band); Nickolaus E. Leggett, Amateur Radio Operator N3NL, Comments at 3 (Leggett Comments) (contending that amateur radio needs continuing millimeter-wave allocations); Ronald E. Telsch Comments at 1 (amateur radio operator opposing the proposed rulemaking due to the potential for interference to primary users); s*ee also* Bosch Comments at 21 (stating that a continued amateur radio allocation in the entire 77-81 GHz band is reasonable).

[55] *See, e.g.*, ARRL Comments at 7 (stating that "there is a large and increasing investment in equipment for this band").

[56] Systems characteristics and compatibility of automotive radars operating in the frequency band 77.5-78 GHz for sharing studies, Report ITU-R M.2322-0 (11/2014) (ITU-R Report), https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-M.2322-2014-PDF-E.pdf.

[57] ARRL Comments at 5, 12; *see also* Bosch Comments at 15, 21-22.

[58] *See, e.g.*, Automotive Group Comments at 14-15.

[59] *See* ITU-R Report at 3, 20, 34. *But cf.* Nickolaus E. Leggett, Amateur Radio Operator N3NL, Reply at 3-4 (concerned about the potential for interference to amateur millimeter-wave observatories that are typically located near public roads due to radar signals from thousands of automobiles).

operations in the millimeter-wave bands.[60] Also, the risk for potential interference is mitigated by the directionality of vehicular radars' antennas – downward in orientation and mounted on a low position on the vehicles.[61] Further, amateur operations are not widely deployed and the high path loss associated with transmissions in the millimeter-wave bands makes coexistence of amateur operations and vehicle radars possible.[62] We thus conclude that we can lift the suspension of amateur operations in the 76-77 GHz band and allow amateurs to proceed with their operations in the entire 76-81 GHz band.[63]

16. However, to address commenters' concerns about potential interference to vehicular radars from amateur operations, we make changes to our allocation and service rules to realize successful shared use of the entire band. First, in conjunction with adding the primary RLS allocation in the 77.5-78 GHz band to match the primary RLS allocations in the 76-77.5 GHz and 78-81 GHz bands (thereby making the entire 76-81 GHz band available for licensed radar applications), we modify the Amateur Service and Amateur-Satellite Service allocations in the 77.5-78 GHz band from primary to secondary status to match the secondary Amateur Service and Amateur-Satellite Service allocations in the remainder of the 76-81 GHz band. We recognize that some commenters suggest that the Amateur Service and Amateur-Satellite Service allocations could be co-primary with RLS in the 77.5-78 GHz band.[64] While doing so arguably would meet the objective of establishing a comprehensive and uniform approach to amateur use of the band on these frequencies, we cannot conclude that it would support our further goal of successfully migrating vehicular radars to the 76-81 GHz band. As secondary users in the 76-81 GHz band, amateurs will have an obligation to operate in a manner that minimizes the potential for harmful interference to licensed radar applications that will operate under the primary RLS allocation throughout the entire 76-81 GHz band, and cannot claim protection from harmful interference from any primary service.[65] If amateurs cause any harmful interference, they will be required to provide an immediate remedy, up to and including terminating their operations.

17. Second, as an added protection against potential interference to vehicular radar operations, we will amend the Part 97 Amateur Radio Service rules to specify the maximum equivalent isotropically radiated power (EIRP) that Amateur Service and Amateur-Satellite Service stations in the 76-81 GHz band may transmit.[66] Currently, a 55 dBm peak EIRP is allowed for vehicular radars in the 76-77 GHz band in Part 15 of the Commission's rules.[67] In contrast, the Part 97 rules for the Amateur

[60] *See* ARRL Comments at 8-9.

[61] ARRL Comments at 10; *see also* Barry Malowanchuck, PE, Amateur Radio Operator VE4MA/W7, Comments at 9 (arguing that taking into account the somewhat remote locations used for amateur operations, and the very high directivity of amateur antennas, the likelihood of amateur interference to vehicular radars is small).

[62] Notably, at 79 GHz, the free space path loss at 1 km is approximately 130 dB, which means that the power of the signal has decreased 10 trillion fold from the original power of the signal.

[63] Because we are not removing the Amateur Service and Amateur Satellite-Service allocations from the 76-81 GHz band, we need not consider the proposal to allocate the 75.5-76 GHz band to the Amateur Service as replacement spectrum. *See NPRM*, 30 FCC Rcd at 1644, para. 66; Automotive Group Comments at 15; Bosch Comments at 21; Robert Bosch, LLC Reply at 26 (Bosch Reply); Leggett Comments at 3.

[64] *See* Thomas D. Williams, Amateur Radio Operator WA1MBA, Comments at 9 (arguing that until an analysis shows that the Amateur Service cannot operate without causing interference to vehicular radar operations, it should continue to be allocated on a primary basis in the 77.5-78 GHz band); Bosch Comments at 21 (stating that the co-primary allocation for amateur radio at 77.5-78 GHz is both necessary for radio amateurs and compatible with vehicular radars).

[65] *See* 47 CFR § 2.105(c)(2)(i)-(ii).

[66] The Amateur Radio Service includes the Amateur Service and the Amateur-Satellite Service. 47 CFR § 97.3(a)(2).

[67] 47 CFR § 15.253(d)(2).

Radio Service permit unlimited EIRP.[68] ARRL opposes additional restrictions in the Part 97 rules, arguing that the power used by amateurs in the 76-81 GHz band is lower than 55 dBm peak EIRP.[69] However, amateur licensee Gary Lauterbach reports of amateurs that are operating with an EIRP ranging from 66-71 dBm, exceeding the allowable vehicular radar peak EIRP limit.[70] Without some limitation, even those amateurs that do operate at the limits described by ARRL might not continue that practice indefinitely. Although Bosch contends that no changes to the Part 97 rules are necessary to accommodate compatible sharing between amateur radio and automotive radar operations,[71] Delphi Automotive Systems (Delphi) supports adopting a single maximum emissions limit that would apply to all operations in the 76-81 GHz band.[72] Furthermore, Lauterbach asserts that reasonable EIRP limits combined with physical separation and narrow bandwidth modulation will preclude any concerns of amateur interference to vehicular radar operations.[73] We agree with Delphi and Lauterbach, and accordingly specify a peak EIRP of 55 dBm for operations of the amateur radio services in the 76-81 GHz band, i.e., the same as the allowable vehicular radar peak EIRP limit.[74] For those amateurs currently operating at EIRP levels greater than 55 dBm, we believe that this rule will require only a modest decrease in their transmitted power and should not significantly affect their operations.

18. The rule changes we adopt modifying the regulatory status of amateur stations and capping their power levels will ensure the continued operation of amateur stations in this band, and are a reasonable alternative to expanding the suspension of amateur operations from the 76-77 GHz band to the remainder of the 76-81 GHz band or removing the amateur allocations altogether from the 76-81 GHz band. In addition, these changes, coupled with the nature of amateur operations in the band (e.g., largely experimental, occurring temporarily on mountaintops and locations where motor vehicle operation is not typical, and using antennas mounted on masts as high as practical),[75] will ensure that the potential for harmful interference from amateur operations to vehicular radar operations in the 76-81 GHz band is negligible and satisfy our efforts to ensure protection for the important safety functions that vehicular radars will provide.

3. RAS and SRS (space-to-Earth) Allocations in the 77.5-78 GHz Band

19. As noted above, the 76-77.5 GHz and 78-81 GHz bands are currently allocated in the U.S. Table to the RAS on a primary basis; the 77.5-78 GHz band is allocated to the RAS on a secondary basis; and the entire 76-81 GHz band is allocated to the SRS (space-to-Earth) on a secondary basis. The

[68] *See* 47 CFR § 97.313(b) (the only limitation is on the transmitter power; there is no mention of EIRP).

[69] *See* ARRL Comments at 8-9 (relying on Table 3 in the ITU-R Report to argue that amateur stations use peak EIRP ranging between 41-54 dBm).

[70] *See* Lauterbach Comments at 5-6. Although Lauterbach suggests using a sliding amateur signal emissions limit based on the separation distance of an amateur station from a road along with a limitation to narrow bandwidth modulation for mitigating the risk of amateur interference to vehicular radars, we believe that the single emissions limit that we are adopting is preferable due to its simplicity and ease of compliance. By contrast, a sliding scale based on the distance of an amateur station from a road (especially in cases where multiple roads are involved) could become complicated to comply with and difficult to enforce.

[71] *See* Bosch Comments at 15.

[72] *See* Delphi Automotive Systems Comments at 2-3 (Delphi Comments) (suggesting this course if we decide to retain amateur use of the 76-81 GHz band).

[73] *See* Lauterbach Comments at 8.

[74] *See* Appendix A to this *Report and Order* at § 97.313(m).

[75] *See* Bosch Comments at 22 n.33 and accompanying text.

NPRM sought comment on possibly upgrading the RAS and SRS (space-to-Earth) allocations in the 77.5-78 GHz band from secondary to primary status.[76]

20. The National Radio Astronomy Observatory (NRAO) and the National Academy of Sciences' Committee on Radio Frequencies (CORF) support upgrading the secondary RAS allocation in the 77.5-78 GHz band to primary status.[77] NRAO claims that vehicular radars may point near the boresight of a radio astronomy antenna, commonly visible from roads on higher ground, which could have a significant impact upon radio astronomy observations in the 77-81 GHz portion of the band.[78] CORF asserts that upgrading the RAS allocation would clarify the need to protect this service and may also prevent harmful interference to the RAS from transmitters at 77.5-78 GHz.[79] On the other hand, Bosch argues that it is unnecessary to make any changes to the RAS allocations in the 76-81 GHz band, stating there have been no reports of harmful interference to the RAS in the U.S. or Europe since 1999 when vehicular radar operations began operating in the 76-77 GHz band, and studies indicate that 76-81 GHz band vehicular radars are compatible with RAS operations in the band.[80] Bosch states that NRAO's vehicular radar interference scenario is unlikely because the roads near radio astronomy observatories do not lead directly towards an observatory's antenna, and vehicular radars' downward antenna orientation will significantly mitigate any potential interference to RAS operations.[81]

21. To further the objectives of this proceeding, that is to support licensed vehicular radar use across a full five gigahertz block of millimeter-wave spectrum, we have decided to add a primary RLS allocation in the half a gigahertz of spectrum (i.e., 77.5-78 GHz) that previously had no RLS allocation. We find that this addition does not introduce any new interference considerations for RAS operations, especially given the characteristics of vehicular radar operations and a history of no reported interference to RAS from vehicular radar operations in the portion of the band where RLS is primary.[82] However, while we agree with Bosch that it is not necessary to modify the existing RAS allocation, we nevertheless find that such a modification would be useful. Important scientific research is conducted across the 76-81 GHz range, and maintaining the secondary RAS allocation in a portion of the band would suggest a distinction between RAS use of the 76-77.5 GHz/78-81 GHz bands and the 77.5-78 GHz band that does not exist. Given the introduction of a primary RLS allocation in the band, the inconsistent status afforded

[76] *NPRM*, 30 FCC Rcd at 1637, para. 40. The proposed rules in Appendix B of the *NPRM* continued to reflect the existing secondary allocations in the 77.5-78 GHz band. *Id*. at 1651.

[77] *See* National Radio Astronomy Observatory Comments at 10 (NRAO Comments); National Academy of Sciences' Committee on Radio Frequencies Comments at 4 n.2 (CORF Comments). There are two RAS facilities in the United States that currently observe in the 76-81 GHz band: the Arizona Radio Observatory, with facilities on Kitt Peak, and the National Radio Astronomy Observatory at Green Bank, West Virginia. *See* CORF Comments at 10.

[78] *See* NRAO Comments at 8 & n.5.

[79] *See* CORF Comments at 4 n.2.

[80] *See* Bosch Comments at 15-20 (citing the ITU-R Report at 3, 20, 34, which concludes that vehicular radar operations in the 76-81 GHz band are compatible with RAS and other incumbent operations in the band).

[81] *See* Bosch Reply at 19.

[82] Vehicular radar sensors are generally mounted on vehicles near the ground, with downward directed transmissions, resulting in significant angular attenuation of the signal towards an observatory's antenna. These factors, along with the high free space path loss associated with transmissions in this frequency band (*see supra* note 62) and the widespread shielding typically provided by the terrain in the remote RAS observatory locations, support our finding that vehicular radar operations in the 77.5-78 GHz band will not have any more potential to cause harmful interference to RAS operations in the 76-81 GHz band than vehicular radars that now operate in the 76-77 GHz band, and have not caused harmful interference to RAS operations in the 76-81 GHz band. Significantly, while vehicular radars will be operating in a larger bandwidth and likely in increased numbers, the fundamental characteristics and nature of their use is not changing.

to the RAS – and any potential confusion it may cause – is particularly relevant. Furthermore, in the unlikely event that there were to be harmful interference between vehicular radars and RAS, it would be difficult to determine whether the radars were operating in the portion of the band where RAS had primary or secondary rights. By making both services co-primary throughout the band, we provide regulatory consistency between the two services and eliminate the potential problem, in the event of harmful interference, of determining protection rights in favor of addressing and mitigating the interference concern.

22. CORF also supports upgrading the secondary SRS (space-to-Earth) allocation in the 77.5-78 GHz band to primary status.[83] We find that the addition of a primary RLS allocation in 77.5-78 GHz band does not introduce any new interference considerations that would justify upgrading the secondary SRS (space-to-Earth) allocation in this band to primary status, and we therefore maintain its current secondary status. As noted above, with the significant angular attenuation of vehicular radars' transmissions towards an observatory's antenna, coupled with the high free space path loss associated with transmissions in this frequency band, and widespread shielding typically provided by the terrain in the remote locations of observatories,[84] vehicular radar operations in the 77.5-78 GHz band will not have any more potential to cause harmful interference to SRS (space-to-Earth) operations in the 76-81 GHz band than vehicular radars that now operate in the 76-77 GHz band, and have not caused harmful interference to SRS (space-to-Earth) operations in the 76-81 GHz band. SRS (space-to-Earth) has a secondary allocation throughout the band, and so the mixed allocation status that served as the basis for our decision to make RAS primary is not relevant here.[85]

23. CORF and NRAO proffer the idea of an on/off mechanism for vehicular radars that would automatically turn off the radars in the pre-coordinated vicinity of RAS observatories to prevent vehicular radars from interfering with RAS operations.[86] We agree with the commenters who question the practicality of a manual or automatic on/off switch and coordination zones for vehicular radars, especially given the size and scope of the automotive fleet in this country as compared to the two RAS facilities that operate in the 76-81 GHz band.[87] The potential for interference to the two relevant RAS facilities requires that there is a confluence of factors, including the observatory antenna pointing at a low elevation angle in the direction of a road, vehicular radars' antennas pointing toward the bore sight of the

[83] *See* CORF Comments at 4 n.2.

[84] *See supra* notes 62 and 82; *see also* Federal Communications Commission, Public Safety Tech Topic #17 – Propagation Characterization at 2, 8-9, https://www.fcc.gov/help/public-safety-tech-topic-17-propagation-characterization (foliage in the path of a signal will create situations where the signal is attenuated at a faster rate than predicted by the free space path loss).

[85] We also note that retaining the status quo for the SRS (space-to Earth) allocation in this band is consistent with the International Table of Frequency Allocations. *See* 47 CFR § 2.106.

[86] *See* CORF Comments at 10 (proposing the use of Global Positioning System functionality within a limited radius around RAS observatories, or a manual on/off switch); NRAO Comments at 9-10 (arguing for operator-controlled on/off switches and large location-based coordination zones).

[87] *See* The Former Strategic Automotive Radar Frequency Allocation Group, Caterpillar, Delphi Automotive, and General Motors Company Reply at 7 (Automotive Group Reply) (contrasting the expense of implementing this proposal throughout the entire U.S. automobile fleet with its estimate that ten vehicles pass in view of one RAS facility per day); Bosch Reply at 17, 20 (arguing that requiring radars to be automatically shut off through the use of GPS would restrict vehicular radars to certain vehicle types or equipment packages and significantly constrain the deployment and usability of vehicular radars' safety features; use of coordination zones would unnecessarily burden vehicular radar systems by requiring that they only be used with a vehicular GPS system); Letter from Alan G. Fishel, Counsel to UATC, LLC, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 1 (filed Jan. 15, 2016) (UATC Jan. 2016 *Ex Parte*) (opposing NRAO's and CORF's proposals for a manual or GPS-determined on/off switch). *See also* CEA Reply at 9 (arguing against imposing either manual or automatic on/off switch requirements due to concerns about reliability and safety, as well as cost).

observatory's antenna, and being in close proximity with no intervening objects that would attenuate the signal. We also observe that the two RAS sites in question are located in controlled areas where they may have the ability to restrict unauthorized vehicles or otherwise take preventative measures that are far more economical and sensible than requiring shut-off features for every vehicle equipped with these radars. For example, to the extent that vehicles have the capability to turn off radar-enhanced features (e.g., parking assist), signage directing drivers to turn off such radar-enabled features might be an effective preventative measure. For these reasons, we decline to adopt CORF's and NRAO's proposals for an automatic or manual on/off switch and coordination zones for vehicular radars.

24. This is a visual summary of the U.S. allocations in the 76-81 GHz band showing the changes we are adopting in this *Report and Order* for the Radiolocation, Amateur and Amateur-Satellite Services, and Radio Astronomy allocations; there are no changes to the Space Research Service allocation:[88]

<table>
<tr><th colspan="2">Resultant U.S. Allocations in the 76-81 GHz Band
(Radio services printed in all capitals are primary services; services printed in normal characters are secondary services.)
(Not to scale. For illustration purposes only.)</th></tr>
<tr><td colspan="2">76-81 GHz GHz
RADIOLOCATION</td></tr>
<tr><td>76-77 GHz
Amateur</td><td>77-81 GHz
Amateur
Amateur-satellite</td></tr>
<tr><td colspan="2">76-81 GHz
RADIO ASTRONOMY</td></tr>
<tr><td colspan="2">76-81 GHz
Space research (space-to-Earth)</td></tr>
</table>

B. Consolidating Vehicular Radar Operations into the 76-81 GHz Band

25. As discussed above, with the allocation of the entire 76-81 GHz band to the Radiolocation Service, we will allow vehicular radars to operate in the entire band. By doing so, we support the continued growth and evolution of vehicular radar applications by ensuring that vehicle radar developers and manufacturers have sufficient spectrum to allow for design flexibility for these systems. Providing the additional four gigahertz of spectrum will allow for integration of all types of vehicular radar applications, including the numerous safety-related offerings that have been developed and deployed under our existing rules, and that benefit the traveling public on a daily basis. The record shows broad support for this decision, with commenters describing how access to this spectrum is necessary to support the deployment of important vehicular radar applications and provide associated public benefits.[89]

[88] For informational purposes, our final rules also reflect primary RLS and RAS allocations at 77.5-78 GHz in the Federal portion of the U.S. Table, pursuant to coordination with the Interdepartment Radio Advisory Committee of the National Telecommunications and Information Administration. *See* Appendix A (Final Rules).

[89] *See, e.g.*, Automotive Group Comments at 7 (describing how "providing vehicular radar with expanded access to the 77-81 GHz band will serve the public interest"). *See also* Mercedes-Benz USA, LLC Comments at 3 (Mercedes-Benz Comments) (stating that "expanding the operational range to 76-81 GHz will only further increase the availability of safety technologies for vehicles" while also promoting future autonomous vehicle driving technologies); Letter from Andrew J. York, Executive Director, Federal Affairs, General Motors Company, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 1 (filed March 21, 2017) (suggesting that prompt adoption of the *NPRM*'s proposed rules "would provide the regulatory certainty necessary for automakers to leverage SRRs' safety applications for their autonomous vehicles" and "potentially other safety initiatives"); Letter from Richard F. Lopez, Director, Federal and Administration Affairs, General Motors Company, to Marlene H.

(continued….)

Therefore, we adopt rules to make the entire 76-81 GHz band available for vehicular radar operations,[90] as well as the Commission's proposal to consolidate future vehicular radar use into the 76-81 GHz band, thus ensuring efficient use of spectrum resources.[91]

1. Removing Unlicensed Vehicular Radar Operations from the 16.2-17.7 GHz and 46.7-46.9 GHz Bands

26. As part of the Commission's efforts to consolidate future vehicular radar use into the 76-81 GHz band, the *NPRM* noted that there is little or no use of vehicular radars in the 16.2-17.7 GHz and 46.7-46.9 GHz bands, and sought comment on modifying the Part 15 rules to no longer approve vehicular radar devices for operation in these bands.[92] No commenters opposed this suggestion. Rule section 15.252 provides technical rules for radar operations in the 16.2-17.7 GHz band for back-up assistance when a vehicle is in reverse, and rule section 15.253 provides technical rules for radar operations in the 46.7-46.9 GHz band for general vehicular radar systems.[93] An examination of the Commission's equipment authorization database shows that only one device was authorized under Part 15 sixteen years ago to operate in the 16.2-17.7 GHz band,[94] and no equipment has been authorized to operate under Part 15 in the 46.7-46.9 GHz band. Given the dearth of use of these bands by vehicular radar systems and lack of opposition from the sole manufacturer of radar equipment in the 16.2-17.7 GHz band,[95] we delete the references to vehicular radar operations in the 16.2-17.7 GHz and 46.7-46.9 GHz bands from our Part 15 rules,[96] and we will not accept applications for equipment certification under these rules effective upon the adoption of this *Report and Order*.[97] In addition, we prohibit the continued manufacture, importation, marketing, sale, and installation for use in the United States of such equipment in the 16.2-17.7 GHz band under the sole existing equipment authorization, FCC ID No. L2C0004TR. We grandfather, for the life of the equipment, any vehicular radars that are already installed or in use under this authorization, thus allowing such systems to continue operating for the life of the vehicle or until the supply of existing equipment necessary for maintenance is exhausted.[98] While our prohibition of equipment certification applications in the time period between the adoption and effective date of the rules will ensure that no

(Continued from previous page)
Dortch, Secretary, FCC, ET Docket No. 15-26, at 1 (filed April 10, 2017) (supporting prompt adoption of the *NPRM*'s proposed rules so SRRs can be "used for advanced safety features such as forward looking object detection and avoidance, collision warning, lane change assistance, blind-spot detection, and pedestrian protection").

[90] *See* Appendix A (Final Rules).

[91] *NPRM*, 30 FCC Rcd at 1638, para. 43. *But see infra* para. 32 (consolidation does not include Part 15 narrowband radar equipment that operates in the 24.075-24.175 GHz and 24.0-24.25 GHz bands pursuant to Sections 15.245 and 15.249 of the rules, respectively).

[92] *Id.* at 1638, paras. 43-44.

[93] *See* 47 CFR §§ 15.252, 15.253.

[94] *See* FCC ID No. L2C0004TR, Delphi Electronics and Safety (June 1, 2000).

[95] Delphi did not oppose deletion of vehicular radars from the 16.2-17.7 GHz band. *See* Delphi Comments at 1-2, 4.

[96] *See* Appendix A (Final Rules) (removing references to the 16.2-17.7 GHz band from Section 15.252, and removing references to the 46.7-46.9 GHz band from Section 15.253).

[97] *See* 5 U.S.C. § 553(d)(3) (providing an exception to the required 30 days after Federal Register publication for the effectiveness of a rule when there is good cause published with the rule).

[98] We note that no Class II permissive changes will be allowed for equipment grandfathered in these frequencies. Under the Commission's rules, a Class II permissive change includes modifications to certified equipment which degrade the performance characteristics as reported to the Commission at the time of the initial certification. Such degraded performance must still meet the minimum performance requirements of the applicable rules. Class II permissive changes may be made in certificated equipment without requiring a new application for and grant of certification. *See* 47 CFR §§ 2.1043(b), (b)(2).

new equipment operates in these bands, it does not detrimentally affect any radar manufacturers because of the scarce use of these bands, and the newly created opportunity to operate in a much larger swath of contiguous spectrum with the adoption of this *Report and Order*.

2. Phasing out Unlicensed Wideband and Ultra-Wideband Vehicular Radar Operations in the 23.12-29 GHz and 22-29 GHz Bands Respectively

27. As part of the Commission's efforts to consolidate future vehicular radar use into the 76-81 GHz band, the *NPRM* also proposed to phase out unlicensed wideband vehicular radars authorized under Section 15.252 to operate in the 23.12-29.0 GHz band, and unlicensed UWB vehicular radars authorized under Section 15.515 to operate in the 22-29 GHz band (collectively, "unlicensed 24 GHz wideband and UWB vehicular radars"). Specifically, the *NPRM* proposed to prohibit certification of new vehicular radars that do not operate in the 76-81 GHz range 30 days after publication of final rules in the Federal Register (i.e., the effective date of the final rules in this proceeding), but to grandfather, for the life of the equipment, unlicensed 24 GHz wideband and UWB vehicular radars that are already installed or in use.[99]

28. Several commenters associated with the automotive industry agree with the proposals to cease certification of new unlicensed 24 GHz wideband and UWB vehicular radars as of the effective date of the final rules in this proceeding, and to phase out future use of unlicensed 24 GHz wideband and UWB vehicular radars.[100] Notably, the Motor & Equipment Manufacturers Association (MEMA) argues that "absent an early date for ending 24 GHz UWB radar equipment certifications and a firm sunset date for installation of new 24 GHz UWB vehicular radars in automobiles, there would be a disincentive to global harmonization of automobile radar technology at 76-81 GHz and an unnecessary delay in the redeployment of the 24 GHz band for other purposes."[101] Other commenters associated with the automotive industry express concern with the Commission's proposals to phase out future use of unlicensed 24 GHz wideband and UWB vehicular radars.[102] Parties were especially concerned that prohibiting the certification of new vehicular radars that do not operate in the 76-81 GHz band beginning

[99] *NPRM*, 30 FCC Rcd at 1638, paras. 43-44.

[100] *See, e.g.*, Letter from Paul Scullion, Senior Manager, Vehicle Safety and Connected Automation, Association of Global Automakers, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 1-2 (filed Feb. 23, 2017) (arguing that by ceasing certification of new unlicensed 24 GHz wideband and UWB vehicular radars by the effective date of the rules in this proceeding and prohibiting the manufacture, marketing, importation, sale, and installation of such devices after January 1, 2022, "vehicular radar operations in the 24 GHz band would not extend in perpetuity, nor would there be a need for perpetual use of the spectrum as existing equipment reaches the end of its useful life and the automotive industry develops, tests, and sells new systems operating in the 77-81 GHz band"); Letter from Christopher D. Imlay, Counsel for Robert Bosch, LLC, to Marlene H. Dortch, Secretary FCC, ET Docket No. 15-26, at 2 (filed Nov. 29, 2016) (contending that it is reasonable to cease equipment certifications for new unlicensed 24 GHz wideband and UWB vehicular radars as of the effective date of the final rules in this proceeding, grandfather unlicensed 24 GHz wideband and UWB vehicular radars already installed and in use for the life of the motor vehicle, and continue to permit new installations of certified unlicensed 24 GHz wideband and UWB vehicular radars until a fixed sunset date).

[101] Letter from Leigh S. Merino, Senior Director, Regulatory Affairs, Motor & Equipment Manufacturers Association (MEMA) to Tom Wheeler, Chairman, FCC, Julius Knapp, Chief, Office of Engineering and Technology, ET Docket No. 15-26, at 3 (filed Dec. 21, 2016) (MEMA Dec. 2016 *Ex Parte*).

[102] *See, e.g.*, Alliance of Automobile Manufacturers, Inc. Comments at 5-6 (Alliance Comments); ASC Comments at 3-4; Automotive Group Comments at 9-11; Continental Comments at 1; Mercedes-Benz Comments at 3-4; Alliance June 2016 *Ex Parte*, attached presentation at 4-5; Letter from Ari Q. Fitzgerald to Marlene H. Dortch, Secretary, FCC (on behalf of Alliance of Automobile Manufacturers, FCA US LLC, Mercedes-Benz USA, LLC and Toyota), ET Docket No. 15-26, attached presentation at 1 (filed May 11, 2017) (Alliance May 2017 *Ex Parte*).

30 days after the publication of final rules in the Federal Register would be insufficiently short.[103] Parties suggest we continue accepting equipment certification applications for all unlicensed 24 GHz wideband and UWB vehicular radars and forgo a phase-out altogether,[104] or at a minimum, that we harmonize the phase-out of unlicensed 24 GHz wideband and UWB vehicular radars with that adopted for 24 GHz vehicular radars operating in the European Union (EU), i.e., a January 1, 2022 phase-out date.[105] A few commenters submit that the Commission should continue to grant certifications for unlicensed 24 GHz wideband and UWB vehicular radars until at least January 1, 2022,[106] and allow in perpetuity the manufacture, marketing, sale, installation, and operation of such equipment.[107] Some commenters point out that, at a minimum, they be allowed to manufacture, import, sell, install, and make permissive changes to 24 GHz wideband and UWB vehicular radar equipment for the purposes of repairing or replacing defective, damaged, or potentially malfunctioning devices that were installed in vehicles sold before the sunset date, for the life of the vehicle.[108]

[103] *See, e.g.*, Automotive Group Comments at 10 (asserting that automobile manufacturers are already finalizing their plans for model year 2022 vehicles, and some may already be contemplating use of new 24 GHz wideband or UWB vehicular radars in those vehicles).

[104] For example, several parties contend that eliminating equipment certification for new unlicensed 24 GHz wideband and UWB vehicular radar equipment will deprive automobile manufacturers of needed flexibility, and will "stymie the improvement of existing 24 GHz vehicular radar systems." Alliance June 2016 *Ex Parte*, attached presentation at 5. *See also* Alliance Comments at 5-6; Letter from Ari Q. Fitzgerald to Marlene H. Dortch, Secretary, FCC (on behalf of Alliance of Automobile Manufacturers and Association of Global Automakers), ET Docket No. 15-26, at 2 (filed July 22, 2016) (Alliance Jul. 2016 *Ex Parte*); Automotive Group Reply at 9; Letter from Ian Musselman, Director, Government Affairs, Continental Automotive, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 1 (filed Aug. 1, 2016) (Continental Aug. 2016 *Ex Parte*); Letter from Ari Q. Fitzgerald, Counsel to Mercedes-Benz USA, LLC to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 6 (filed Aug. 4, 2016) (Mercedes-Benz Aug. 2016 *Ex Parte*).

[105] *See*, *e.g.*, Mercedes-Benz Comments at 4; Automotive Group Reply at 9; Letter from Ari Q. Fitzgerald, Counsel to Mercedes-Benz USA, LLC to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, attached presentation at 3 (filed July 15, 2016) (Mercedes-Benz Jul. 2016 *Ex Parte*); Continental Aug. 2016 *Ex Parte* at 1. In 2005, the European Commission (EC) allowed temporary use of the 21.65-26.65 GHz band for newly installed short range automotive radars until June 30, 2013. *See Commission Decision of 17 January 2005 on the harmonization of the 24 GHz range radio spectrum for the time-limited use by automotive short-range radar equipment in the Community*, 2005/50/EC, at Articles 2 and 5, http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32005D0050. In 2011, the EC extended the transition date for the 24.25-26.65 GHz band to January 1, 2022 for equipment type-approved before January 1, 2018, but retained the June 30, 2013 transition date for the 21.65-24.25 GHz band. *See Commission Implementing Decision of 29 July 2011 amending Decision 2005/50/EC on the harmonization of the 24 GHz range radio spectrum for the time-limited use by automotive short-range radar equipment in the Community*, 2011/485/EU, at Article 1, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011D0485. After these dates (June 30, 2013 for the 21.65-24.25 GHz band; January 1, 2022 for the 24.25-26.65 GHz band), use of these bands for short-range vehicular radars will not be permitted in the EU, except where the original equipment was installed prior to those dates. *See* 2005/50/EC at Article 3, 2011/485/EU at Article 1.

[106] *See* Alliance Jul. 2016 *Ex Parte* at 2; Mercedes-Benz Aug. 2016 *Ex Parte* at 6; Alliance May 2017 *Ex Parte*, attached presentation at 1.

[107] *See* Alliance Jul. 2016 *Ex Parte* at 2; Continental Aug. 2016 *Ex Parte* at 1; Mercedes-Benz Aug. 2016 *Ex Parte* at 6.

[108] *See* Letter from Scott Delacourt, Counsel to General Motors Company, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 1 (filed June 30, 2017) (General Motors June 2017 *Ex Parte*); Letter from Ari Q. Fitzgerald, Counsel to Alliance of Automobile Manufacturers, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, attached presentation at 1 (filed June 29, 2017) (Alliance June 2017 *Ex Parte*). Both parties cite the National Highway Traffic Safety Administration's organic statute, 49 U.S.C. § 301 *et. seq.*, for the proposition that the ability to repair and replace defective or potentially malfunctioning equipment is required to comply with the

(continued….)

29. It will not serve the public interest to certify new unlicensed 24 GHz wideband and UWB vehicular radars through January 1, 2022, or allow such equipment to be manufactured, imported, marketed, sold, and installed in perpetuity for use in new vehicles in the United States. Doing so would impede our goal of consolidating future vehicular radar operations in the 76-81 GHz band. As Bosch notes, "the point of the … proceeding was to further the worldwide plan to consolidate automotive radars in the 76-81 GHz band," and the "[European Conference of Postal and Telecommunications Administrations (CEPT)] and the European Commission have concluded that [this] band should be the long-term, globally harmonized frequency band for all automotive radar applications in lieu of [22-29] GHz."[109] Moreover, the Part 95 service rules that we are adopting for vehicular radar operations in the 76-81 GHz band[110] will provide those radar operations protection from harmful interference that is not currently available for unlicensed 24 GHz wideband and UWB vehicular radars.[111] Thus, we believe the best course of action is to require unlicensed 24 GHz wideband and UWB vehicular radar equipment to phase out use of the 22-29 GHz band.

30. On the other hand, we agree that the *NPRM*'s proposal to cease certification of new unlicensed 24 GHz wideband and UWB vehicular radar equipment 30 days after the effective date of the rules in this proceeding failed to account for the long automotive development cycle and manufacturers' ongoing plans to use technologies with wide signal bandwidths. We will provide more time for the phase-out than proposed in the *NPRM*, since that deadline could unduly burden manufacturers that may already have made significant investments in developing new unlicensed 24 GHz wideband and/or UWB vehicular radars. For these reasons, we will cease certifying unlicensed 24 GHz wideband and UWB vehicular radar equipment on or after one year from the date of publication in the Federal Register of this *Report and Order*. Given that our records show a very small number of equipment certifications for unlicensed 24 GHz wideband and UWB vehicular radars, we do not believe such a course of action will be burdensome for manufacturers.[112] We will continue to allow the manufacture, importation, marketing, sale, and installation of, as well as Class II permissive changes[113] for, previously certified unlicensed 24

(Continued from previous page)
statute's obligations to remedy such defects for the life of the vehicle or for 15 years after the vehicle was purchased by its first buyer.

[109] Letter from Ana M. Meuwissen, Director Federal Government Affairs, Robert Bosch, LLC to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 2 (filed Aug. 31, 2016) (emphasis omitted). *Cf.* Alliance June 2017 *Ex Parte*, presentation at 1 (recognizing that "the Commission's goal of consolidating future vehicular radar operations in the 76-81 GHz band promotes the efficient use of spectrum . . . .").

[110] *See infra* Section III.D.

[111] In this regard, portions of the 24 GHz band are being considered for fixed and mobile allocations. *See Use of Spectrum Bands Above 24 GHz For Mobile Radio Services et al.,* GN Docket No. 14-177 et al., Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8148, paras. 383-85 (2016) (proposing to add a mobile allocation to the 24.25-24.45 GHz and 24.75-25.25 GHz bands, a fixed allocation to 24.75-25.05 GHz, and to authorize both fixed and mobile operations in those segments under co-primary fixed and mobile allocations). If that proposal is adopted, and we complete a rulemaking to promulgate service rules and permit licensing in the band, then any remaining unlicensed 24 GHz wideband and UWB vehicular radars, as Part 15 unlicensed devices, would be required to accept interference from these and any other licensed services in the band, and protect any future 24 GHz fixed and mobile operations from harmful interference. 47 CFR § 15.5(b). We do not prejudge the outcome of that pending proceeding, nor base our decision in this one on its eventual outcome. We observe, however, that to the extent the Commission does authorize fixed and mobile operations in the 24 GHz band under co-primary fixed and mobile allocations, the decision in this proceeding to phase out the unlicensed 24 GHz wideband and UWB vehicular radar operations would eliminate the potential for interference between vehicular radar operations and new licensed fixed and mobile operations in the 24 GHz band, while making additional spectrum available for those vehicular radar operations in the 76-81 GHz band.

[112] A staff search of the Commission's equipment authorization database showed that, as of July 5, 2017, only thirteen certifications for unlicensed 24 GHz wideband and UWB vehicular radar devices had been granted.

[113] *See* 47 CFR §§ 2.1043(b), (b)(2). "Class II permissive change" is described in note 98, *supra*.

GHz wideband and UWB vehicular radar devices until January 1, 2022, consistent with the EU transition plan for 24 GHz vehicular radars.[114] After January 1, 2022, we will not permit the manufacture, importation, marketing, sale, or installation of, or Class II permissive changes for, these devices for use in the United States, with one limited exception regarding sale and installation described below.

31. Although it is important to promote the transition of unlicensed 24 GHz wideband and UWB vehicular radars to the 76-81 GHz band, we recognize that it would be impractical and counterproductive to expect drivers to cease using vehicular radar applications that have been installed in their automobiles and forego the important safety features that they provide until the vehicle is replaced. Thus, as we proposed in the *NPRM*,[115] unlicensed 24 GHz wideband and UWB vehicular radars that are already installed or in use by January 1, 2022 may continue to operate in the vehicle. In that regard, we also provide a narrow exception to the phase-out requirements to permit, for the life of the vehicle, the continued sale and installation of unlicensed 24 GHz wideband and UWB radar devices for the exclusive purpose of repairing or replacing defective, damaged, or potentially malfunctioning equipment installed on or before January 1, 2022. This exception is available only when it is not possible to repair or replace the radar equipment designed to operate in the 24 GHz band with radar equipment designed to operate in the 76-81 GHz band,[116] and is limited to the repair and replacement of unlicensed 24 GHz wideband and UWB vehicular radar equipment that has been certified for operation in the 24 GHz band. We expect manufacturers to draw on existing stock of equipment that had been approved before January 1, 2022, and will address requests for additional relief (e.g. manufacture, importation, or product redesign) on a case-by-case basis.[117] In establishing this multi-year transition period, we promote a graceful migration of unlicensed 24 GHz wideband and UWB vehicular radars to the 76-81 GHz band to further our goal of consolidating future vehicular radar use in this band, without unduly impairing the availability or cost of vehicular radars or imposing undue burdens on manufacturers or the public.

32. Finally, at the request of several commenters,[118] we clarify that the proposal with regard to phasing out use of the 22-29 GHz band for wideband and UWB vehicular radar operations that operate under Sections 15.252 and 15.515 of the rules was not intended to apply to the unlicensed radars that operate at 24.075-24.175 GHz and 24.0-24.25 GHz under Sections 15.245 and 15.249 of the rules, respectively. These rules, which are not being modified, authorize a wide variety of devices that include, but are not limited to, vehicular-specific radars. As such, radars that operate under these rules will continue to be certified and can continue to be used in vehicular applications.[119]

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[114] *See supra* note 105.

[115] *NPRM*, 30 FCC Rcd at 1638, para. 44.

[116] We recognize that the components of some unlicensed 24 GHz wideband and UWB vehicular radar systems and 76-81 GHz vehicular radar systems (e.g., radar sensors, transmitter leakage cancellers) are frequency dependent and are not interchangeable. *See Antenna Concepts for Millimeter-Wave Automotive Radar Sensors*, Wolfgang Menzel, Fellow IEEE, and Arnold Moebius. Member IEEE, Proceedings of the IEEE, 2012, Vol. 100, Issue 7 at 2372-2379 (illustrating the frequency dependence of selections of materials, fabrication processes, packaging, and mounting considerations for 24 GHz and 76-81 GHz radar sensors); *Tx Leakage Cancellers for 24 GHz and 77 GHz Vehicular Radar Applications*, Choul-young Kim; Jeong Geun Kim; Joon Ho Oum; Jong Ryul Yang; Dong-kyun Kim; Jung Han Choi; Sang-wook Kwon; Sang-hoon Jeon; Jae-woo Park; Songcheol Hong 2006 IEEE MTT-S International Microwave Symposium Digest at 1402-1406 (illustrating the frequency dependent design characteristics of transmitter leakage cancellers for 24 GHz and 76-81 GHz vehicular radar systems).

[117] *See* 47 CFR § 2.1043(b)(2) (equipment modified under an existing grant of certification must get Commission acknowledgement that the change is acceptable).

[118] *See, e.g.*, Letter from Ari Q. Fitzgerald, Counsel to Mercedes-Benz USA, LLC, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 3 (filed Dec. 14, 2015) (Mercedes-Benz Dec. 2015 *Ex Parte*); Alliance Jul. 2016 *Ex Parte* at 2 n.5; Automotive Group Comments at 11-12; MEMA Dec. 2016 *Ex Parte* at 2.

[119] *See* 47 CFR §§ 15.245, 15.249.

C. Fixed and Other Mobile Radar Operations in the 76-81 GHz Band

1. Fixed Radar Operations

33. The Commission's Part 15 and Part 90 rules already permit certain non-vehicular fixed radar operations in the controlled environment of airport air operations areas.[120] Specifically, FOD detection radars are currently authorized to operate, in airport air operations areas only, as fixed devices in the 76-77 GHz band on an unlicensed basis[121] and as either fixed or mobile FOD detection devices in the 78-81 GHz band on a licensed basis.[122] The *NPRM* discussed the potential use of non-vehicular radar applications outside of airport settings, and proposed to adopt rules that would permit fixed infrastructure radar applications in part or all of the 76-81 GHz band, provided that there was sufficient demand for such uses and that studies could support sharing between the different applications, i.e., vehicular and non-vehicular radars.[123] As discussed below, we are maintaining the existing limitation which restricts non-vehicular fixed radar operations to airport air operations areas. Our decision provides a more certain environment for the successful migration of vehicular radars to the 76-81 GHz band and is appropriate to the record. However, we recognize the possibility that there may be situations in which fixed radars might be compatible with vehicular radars in the band, and do not foreclose further exploration of such scenarios.

34. The *NPRM* proposals drew on the *2012 Radar R&O*, in which the Commission stated its belief that vehicular radars should be able to share the band with fixed radars. There, the Commission did not permit widespread fixed radar operations based on the fact that there was no evidence of demand for fixed radar applications outside of airport settings and because there was no conclusive data addressing compatibility between the two types of radars.[124] In the *NPRM*, the Commission observed that there appeared to be some demand for the possible fixed uses that sharing of the 76-81 GHz band might permit;[125] nonetheless, the Commission recognized that the record may "still be evolving" and the available information is "limited" and "does not have the support of all interested parties in the matter."[126]

35. While several commenters expressed interest in deploying fixed radar applications in the 76-81 GHz band,[127] there is substantial disagreement as to whether such applications could successfully coexist with vehicular radars. Navtech Radar Ltd. (Navtech) contends that if a range of vehicular radar systems can coexist, there are no sound scientific reasons that this cannot be extended to other users,

[120] 47 CFR § 87.5. *See supra* note 14.

[121] 47 CFR § 15.253(c). Such operations are not permitted on aircraft or satellites. *Id*.

[122] *78-81 GHz FOD Detection Radar R&O*, 28 FCC Rcd at 10427, para. 12. A recent search of the Commission's Universal Licensing System database shows that no applications have been submitted for such operations.

[123] *NPRM*, 30 FCC Rcd at 1639-41, paras. 50-55.

[124] *2012 Radar R&O*, 27 FCC Rcd at 7888-89, para. 26.

[125] *NPRM*, 30 FCC Rcd at 1640, para. 52.

[126] *NPRM*, 30 FCC Rcd at 1640-41, para. 53.

[127] *See*, *e.g.*, Mantissa Ltd. Comments at 1, 14-15 (Mantissa Comments); Navtech Radar Ltd. Comments at 2-5 (Navtech Comments); RhiZone Inc. Reply at 1-2 (RhiZone Reply); Sivers IMA Reply at 1 (Sivers Reply); Trimble Navigation Limited Comments at 4-5, 7-9 (Trimble Comments); Letter from Alberto Bicci, President, IDS GeoRadar, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 1-2 (filed Nov. 25, 2016) (IDS Nov. 2016 *Ex Parte*); Letter from Walton K. Stuckey, Freeport McMoRan Inc., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 1 (filed Feb. 1, 2017) (Freeport Feb. 2017 *Ex Parte*). Potential applications include monitoring and automatic incident detection on highways; non-contact measurement; automation, obstacle detection, and navigation for industrial machinery (e.g., port cranes); civil structure monitoring; geophysical monitoring (surface and underground); and various perimeter security applications. *See* Mantissa Comments at 3; Navtech Comments at 1-2; RhiZone Reply at 1; Sivers Reply at 1; IDS Nov. 2016 *Ex Parte* at 2; Freeport Feb. 2017 *Ex Parte* at 1.

technologies, or applications in the band.[128] Several fixed infrastructure proponents describe how their proposed applications will use similar technology and interference mitigation techniques as vehicular radars[129] and comply with the EIRP limits proposed in the *NPRM* to ensure compatibility.[130] Mantissa Ltd. (Mantissa) claims that it can readily implement most of the techniques for mitigation of radar-to-radar interference (e.g., detect interference and change timing of transmit chirps or pulses; application of driving direction specific pre-defined frequency band separation) that the MOre Safety for All by Radar Interference Mitigation (MOSARIM)[131] consortium has identified that contribute to the compatibility between and among various vehicular radar types.[132] Trex Enterprises Corporation urges the Commission to allow the 76-81 GHz band to be used for fixed radiolocation applications, claiming that "well-coordinated non-automotive radars using the same technology could easily coexist without any adverse impact on automotive radar operations."[133]

36. On the other hand, many commenters oppose allowing fixed radar operations in the 76-81 GHz band outside of airport locations, citing potential interference that could compromise the safe operation of vehicular radar systems.[134] Mercedes-Benz claims that fixed infrastructure radar applications are neither built on the same technological platforms as vehicular radars, nor are they similar to vehicular radars; thus, they are likely to cause interference to vehicular radar operations in the 76-81 GHz band.[135] It contrasts vehicular and fixed radar applications, stating that the introduction of fixed radars would introduce a set of applications "with potentially very heterogeneous detection tasks and thus a wide range of signal designs." Mercedes-Benz claims that the signal characteristics of fixed radar systems being considered (e.g., larger detection ranges that use more transmit power and occupy wider bandwidths) would be especially harmful to high-resolution short-range vehicular radars, which need unimpeded

[128] *See* Navtech Comments at 3; Navtech Radar Ltd. Reply at 4 (Navtech Reply).

[129] *See, e.g.*, Mantissa Comments at 11; Trimble Comments at ii, 8-9. Trimble seeks to use the 76-81 GHz band radar technologies to augment and improve its existing three-dimensional (3D) scanning, surveying, mapping, and Geographic Information System (GIS) data collection applications. *Id.* at 3.

[130] *See, e.g.*, NavTech Reply at 3.

[131] MOSARIM, a European Community funded consortium supported by the automotive industry, studied potential vehicular radar interference issues and developed appropriate countermeasures and mitigation techniques with the potential to avoid harmful mutual interference for all traffic scenarios and vehicle constellations. *See* CEPT ECC Working Group FM (13)053, Potential interference between automotive radars and fixed roadside installations in the 76-81 GHz range (Feb. 1, 2013) (CEPT ECC Working Group FM (13)053), at 2, http://www.cept.org/documents/srdmg/9914/srdmg(13)info7_Automotive-radars-and-fixed-installations-in-the-76-81-GHz.

[132] *See* Mantissa Comments at 10-11.

[133] Letter from Thomas Cohen, Counsel for Trex Enterprises Corp., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 5 (filed Feb. 23, 2016); *see also* Mantissa Comments at 11 ("In view of the technological similarity between Mantissa's MSHRS-300X device and vehicle-mounted radar systems,… [a]t worst, potential interference between the MSHRS-300X devices and automotive radar sensors is the same as the potential interference among automotive radar systems"); Navtech Reply at 2-3 (believing "the likelihood of interference is no greater between fixed radar to automotive radar than between automotive to automotive radar"). *Cf.* Letter from Thomas Cohen, Counsel for Trex Enterprises Corp., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, at 2 (filed Feb. 16, 2016) (speculating that "any system architecture" for vehicular radar "will be extremely interference tolerant").

[134] *See*, *e.g.*, Alliance Comments at 3-5; ARRL Comments at 3; Association of Global Automakers, Inc. Reply at 3; ASC Comments at 3; Bosch Comments at 3-4, n.5; Delphi Comments at 3-4; Automotive Group Comments at 12-14; Mercedes-Benz Jul. 2016 *Ex Parte*, attached presentation at 9-17; Alliance June 2016 *Ex Parte*, attached presentation at 3; UATC Jan. 2016 *Ex Parte* at 1.

[135] *See* Mercedes-Benz Aug. 2016 *Ex Parte* at 4.

access to large swaths of spectrum to operate reliably.[136] Similarly, Delphi describes how the use of multiple fixed radar installations could potentially increase the likelihood of interference to vehicular radars.[137] Delphi also notes that the orientation of the radar was a key discussion point in all prior decisions that addressed the use of non-vehicular radar applications.[138] Mercedes-Benz further asserts that tests have shown that Navtech's proposed wideband fixed radar technology will cause harmful interference to vehicular radars.[139] Bosch submits that the European Telecommunications Standard Institute's (ETSI's) Technical Report TR 102 704 V1.2.1, which recommends that fixed outdoor radar operations not be allowed in the 76-77 GHz band with vehicular radar operations, states that where fixed radars overlap in the direction of SRRs on public roads, the surveillance radars potentially blind vehicular radars operating in the same frequency and area.[140]

37. We find merit in the arguments of Mercedes-Benz, Delphi, and similar commenters. The proposal to permit fixed radars outside of airport locations would allow for the introduction of numerous radar devices that could employ different signal designs and operating characteristics, which in turn could be detrimental to vehicular radar operations. First, while fixed radar manufacturers may expect to design equipment that is technically identical to vehicular radars, we cannot guarantee this would happen in practice – the Commission neither proposed nor developed a record for us to mandate device specifications and guidelines. We have a high degree of confidence that vehicular radar interests will continue to work together to ensure compatibility among different vehicular radars based on their existing efforts in this regard, e.g., the comprehensive, worldwide effort to standardize automotive radar operations at 76-81 GHz is the result of years of international work and study,[141] and because widespread interference would undermine the utility and market acceptance of vehicular radars. For example, the MOSARIM consortium has identified several techniques for mitigating radar-to-radar interference that contribute to the compatibility between and among various types of automotive radars.[142]

38. By contrast, the introduction of fixed radar uses without any limitations likely would introduce a much wider variety of use characteristics (e.g., perimeter detection, obstacle detection in

[136] *Id.* at 3-4. Mercedes-Benz contends that since manufacturers design vehicular radar systems to avoid interfering with other vehicular radar systems when operating on the same frequencies, interference between two vehicular radars can only occur in the unlikely event of an overlap in the frequency and time domains of both signals during their detection period and if the victim vehicle is in the field of view of the interfering vehicle. Mercedes-Benz contrasts this scenario by stating a vehicular radar system that passes by a potential non-rotating fixed radar system will not be able to avoid interference that is caused by an overlap in both the frequency and time domains. *Id*. at 5.

[137] Delphi Comments at 4. Delphi asserts that if multiple fixed radars are mounted on elevated platforms along a highway and pointed towards the highway, their beams would not be blocked by adjacent vehicles. As a result, a radar-equipped vehicle "may be in a potential interference environment for an extended period of time and potentially from multiple fixed radars simultaneously." Delphi contrasts this situation with multiple radar equipped vehicles, where the radar line of sight to most vehicles is naturally obstructed – thereby limiting the number of potential interferers. *Id.*

[138] *Id.* at 3 (referencing the requirement that FOD detection radars' signals not illuminate public roadways, and the fact that LPRs' signals are pointed downward towards the reflecting surface and are not pointed along the road).

[139] *See* Mercedes-Benz Jul. 2016 *Ex Parte*, attached presentation at 10-15.

[140] Bosch Comments at 12. *See* ETSI TR 102 704 V1.2.1 (2012-03), Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference document; Short-Range Devices (SRD); Radar sensors for non-automotive; ground based vehicular applications in the 76 GHz to 77 GHz frequency range (2012), at 15, Section 6.2.1.2, www.etsi.org/deliver/etsi_tr/102700_102799/102704/01.02.01_60/tr_102704v010201p.pdf.

[141] Bosch Reply at 10.

[142] *See* MOSARIM Project Final Report, Grant Agreement No. 248231, at 13, Fig. 17 (Dec. 21, 2012), http://cordis.europa.eu/docs/projects/cnect/1/248231/080/deliverables/001-D611finalreportfinal.pdf (MOSARIM Final Report).

industrial settings, highway accident detection), which could complicate the ability of parties to coordinate compatibility among users – as well as the motivation to do so, if some applications prove to be more tolerant of interference than others. In addition, the proposal did not take into account how the wide range of possible fixed radar orientations might affect compatibility with vehicular radars, even though this has been a consideration in past proceedings. For example, the Commission previously found that LPRs can coexist successfully with vehicular radars because LPR equipment is installed in a downward-looking position at fixed locations and the main-beam power limits have been carefully calculated to avoid harmful interference to other radio operations.[143] In this case, we agree that widespread fixed radar deployments could introduce new and unanticipated lines of interference for vehicular radar operations – interference that would be especially detrimental to the existing base of LRR equipment that is not easily upgraded or modified. For these reasons, we find that the Commission's observation in the *NPRM* equating the potential interference of a fixed radar to that of a radar located on a stationary vehicle was overly simplistic,[144] and that there may be use cases in which a fixed radar could well be more interfering.[145]

39. In addition, studies on fixed radars' potential coexistence with vehicular radars have not evolved to the point that we can confidently conclude that fixed radar operations at any location will not cause harmful interference to vehicular radar operations in the band. In that regard, the automotive industry asserts that additional testing should be conducted before we consider allowing fixed infrastructure radars to operate alongside vehicular radars in the 76-81 GHz band.[146] Although Navtech submits European study data to support its view that non-vehicular fixed radar operations can coexist with vehicular radar operations, we are unconvinced based on the limitations of the studies and the uncertainty expressed in the Reports.[147] Moreover, other studies have different conclusions. For example, a 2012 test by the Electronic Communications Committee (ECC) of the CEPT concluded that, in the 76-81 GHz band, there is the potential for interference from roadside fixed radars to vehicular radars.[148]

40. Even though we recognize the innovative nature of some proposed applications of non-vehicular radars in the 76-81 GHz band, we will keep fixed radar applications use of the 76-81 GHz band limited to airport locations, as discussed in further detail below, at this time. An important objective of this proceeding is to facilitate the migration of vehicular radars into the 76-81 GHz band, and we find that

[143] *LPR R&O*, 29 FCC Rcd at 774, para. 29.

[144] *See NPRM*, 30 FCC Rcd at 1641, para. 54 (stating the view that "where two radars are aiming directly at each other, [a] fixed radar should have no more impact on a vehicular radar [than] that from a radar located on a stationary vehicle.")

[145] *See e.g.*, Mercedes-Benz Aug. 2016 *Ex Parte* at 4 and Delphi Comments at 4.

[146] *See, e.g.*, Alliance Comments at 4; Automotive Group Comments at 3; Automotive Group Reply at 2; Bosch Comments at 3-4; Delphi Comments at 3-4.

[147] *See* Navtech Reply at 3 (submitting that ETSI's Technical Report ETSI TR 103 148 V1.1.1 concludes that Navtech's Spectrum Engineering Advanced Monte Carlo Analysis Tool (SEAMCAT) simulation determined that the probability of a scanning infrastructure radar interfering with a vehicular radar is less than that of a vehicular radar interfering with another vehicular radar); E-mail from Richard Poulton, Navtech Radar Limited, to Aamer Zain, Electronics Engineer, FCC, ET Docket No. 15-26 (Feb. 21, 2017, 11:46 EST) (updating the Commission with regard to a recently-approved ECC interference study). *See* ECC Report 262, Studies related to surveillance radar equipment operating in the 76 to 77 GHz range for fixed transport infrastructure (Jan. 27, 2017), http://www.erodocdb.dk/doks/filedownload.aspx?fileid=4317&fileurl=http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP262.PDF. *See also* ETSI TR 103 148 V1.1.1 (2014-06), Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference document (SRdoc); Technical characteristics of Radio equipment to be used in the 76 GHz to 77 GHz band; Short-Range Radar to be fitted on fixed transport infrastructure (2014), www.etsi.org/deliver/etsi_tr/103100_103199/103148/01.01.01_60/tr_103148v010101p.pdf.

[148] *See* CEPT ECC Working Group FM (13)053, *supra* note 131, at 3. The testing used Navtech's fixed Traffic Monitoring System on October 13, 2012. *Id.*, Embedded Annex: MOSARIM Test Campaign Summary.

the public interest is best served by mitigating any risk that fixed radar operations could cause harmful interference to and impair the reliability of vehicular radar operations in the band. Airports represent a unique use environment, where we already have a track record of successful non-vehicular radar deployments and whose characteristics are already familiar to manufacturers who have designed and deployed vehicular radars that operate on the same frequencies. We are not permitting fixed radar operations in the 76-81 GHz band outside of airport air operations areas in order to avoid any possible hindrance to the successful migration of vehicular radars to the 76-81 GHz band. This is particularly important given that vehicular radars offer demonstrated benefits for driver, passenger, and pedestrian safety, and the development of such applications in the band has been identified as integral to the development of self-driving cars and other autonomous vehicles.[149] We acknowledge that, under careful coordination, it might nevertheless be possible for fixed radars to operate in the band at carefully selected locations without causing harmful interference to vehicular radars. Presently, there is insufficient information in the record to develop the specific criteria for a successful coordination process.[150] Interested parties may provide future filings that might provide such detail. We are open to the possibility that specific, limited fixed uses of 76-81 GHz radars outside of airport locations may be possible, provided we can be convinced that such use would not cause harmful interference to vehicular radar operations in the band.

2. Airport Radar Operations

41. Currently, FOD detection radars are operating as fixed devices in the 76-77 GHz band under Part 15[151] and can be authorized as either fixed or mobile devices on a licensed basis under the Commission's Part 90 rules in the 78-81 GHz band, in airport air operations areas only.[152] In the *NPRM*, the Commission proposed to permit FOD detection radar operations throughout the entire 76-81 GHz band on airport grounds only, under the same technical requirements as those provided under Part 15. The *NPRM* also sought comment on allowing non-airborne aircraft-mounted radar operations in airport locations.[153]

42. As detailed below, we find that the successful operation of FOD detection radars authorized under Part 15 serves as a model for permitting a wider range of radar applications, as long as they are not airborne and remain restricted to airport air operations area deployments. Innovation and technology advances as well business opportunities may create other radar applications that can be implemented within the confines of an airport. Airports are carefully controlled environments that have well established practices to manage different authorized users, and there is adequate geographic separation between public roads and airport air operations areas, so expanded use of such radars will not cause harmful interference to vehicular radars.

43. *FOD Detection Radars.* As proposed in the *NPRM*, we will permit FOD detection radar operations at airport locations in the entire 76-81 GHz band under the same technical requirements currently allowed for such operations in the 76-77 GHz band.[154] The record supports the Commission's proposal to expand the spectrum available for FOD detection radars at airports by providing a contiguous

[149] *See* Bosch Comments at 8 nn.14, 15; Mercedes-Benz Dec. 2015 *Ex Parte* at 2; Mercedes-Benz Jul. 2016 *Ex Parte*, attached presentation at 6; Mercedes-Benz Aug. 2016 *Ex Parte* at 1.

[150] Among other things, we would need to consider the particular criteria for protecting vehicles on roadways as well as details regarding the coordination process.

[151] 47 CFR § 15.253(c). Such operations are not permitted on aircraft or satellites. *Id*.

[152] *78-81 GHz FOD Detection Radar R&O*, 28 FCC Rcd at 10427, para. 12. A search of the Commission's Universal Licensing System database shows that no applications have been submitted for such operations; *see also* 47 CFR § 90.103(b).

[153] NPRM, 30 FCC Rcd at 1641-43, para. 56-61.

[154] As discussed below, such operations will be authorized under Part 95 of our rules.

band of spectrum from 76 GHz to 81 GHz.[155] This expanded band will foster the development of technologically improved and cost-effective radar applications that will improve airport operations and provide important benefits to the airlines, airport personnel, and the traveling public.

44. The record also reflects the automotive industry's concerns of potential interference to vehicular radars from the expanded FOD detection radar operations. Bosch and Delphi insist on limiting FOD detection radar operations to airport locations that avoid illumination of public roadways, to minimize the potential for interference to vehicular radars.[156] Mercedes-Benz asserts that, after examination, 76-77 GHz FOD detection radar operations at airport locations that do not illuminate public roadways were found to not create the potential for interference to vehicular radars in the band.[157] On the other hand, Navtech opposes such restrictions, contending that FOD detection radars and vehicular radars can coexist without this limitation.[158] Navtech argues that such a limitation could compromise the full performance of a safety critical device or require additional sensors to be installed, increasing costs and limiting the commercial advantage of high performance systems.[159]

45. We will maintain an airport-based geographic restriction on FOD detection radar operations. This restriction will provide geographic separation between airport-based radar operations and vehicular radar operations on public roads, avoiding any possibility of harmful interference to vehicular radar operations in the 76-81 GHz band. Hence, Bosch and Delphi's concerns over the potential illumination of public roadways are addressed by specifying that FOD detection radars will be permitted in air operations areas on airport grounds. Further, as Xsight Systems, Inc. (Xsight), a manufacturer of FOD detection radars notes, "the limited geographic restriction (i.e., at airports) along with the propagation characteristics of the millimeter wave band yields negligible risk of interference potential between vehicular and FOD detection radars."[160] Our experience thus far supports this assertion. Since 2012, when FOD detection radars were initially permitted at airports,[161] the Commission has not received any reports of harmful interference to vehicular radar operations in the band from FOD detection radars. Furthermore, given that parties disagree on the potential for 76-81 GHz band fixed radar operations outside of airport locations to cause harmful interference to vehicular radar operations in the band,[162] we believe that the restriction for 76-81 GHz band FOD detection radars to operate only in air operations areas at airport locations remains a reasonable condition on their use. An airport-based restriction in air operations areas is not new to FOD detection radars; contrary to Navtech's arguments, judicious equipment selection and placement (e.g., directional antennas) will allow parties to continue to conduct FOD detection radar operations with the same high level of performance and will not introduce new costs that would jeopardize the commercial utility of such operations.

46. As proposed in the *NPRM* and supported by the record, we grandfather, for the life of the equipment, any FOD detection radars that are already installed or in use. This will allow such systems to continue operating pursuant to their current (i.e., Part 15) operating parameters for the life of the

[155] *See* Bosch Comments at 25; Delphi Comments at 2; Navtech Comments at 4; Xsight Systems Comments at 3-5 (Xsight Comments).

[156] *See* Bosch Comments at 25; Delphi Comments at 2. *See also* Xsight Comments at 4 (supporting the restriction that FOD detection radars at airports not illuminate public roadways).

[157] *See* Mercedes-Benz Aug. 2016 *Ex Parte* at 2-3.

[158] *See* Navtech Comments at 4.

[159] *See id.*

[160] Xsight Comments at 4.

[161] *See 2012 Radar R&O*, 27 FCC Rcd at 7888, para. 24; 47 CFR § 15.253(c).

[162] *See supra* para. 39 and accompanying footnotes.

equipment or until the supply of existing equipment necessary for maintenance is exhausted.[163] FOD detection radars are an important safety feature at airports; grandfathering FOD detection radars that are already installed or in use in the 76-77 GHz and 78-81 GHz bands serves the public interest. However, we will not certify any new FOD detection radars under Part 15 or Part 90 of our rules upon adoption of this *Report and Order*.[164] Considering that we are adopting rules to allow for uniform certification of FOD detection radar equipment under Part 95 and for such radar operations in the entire 76-81 GHz band under the same technical parameters as Part 15, we find that there is good cause to avoid situations where applications for such equipment authorizations are filed in the time period between the adoption date and the effective date of this *Report and Order*. If entities want to operate existing FOD detection radar equipment in the 77-78 GHz band (which has not previously been available for FOD detection radar use), such equipment would first have to be certified under our equipment authorization procedures to operate in the 77-78 GHz band under our Part 95 rules.

47. *Aircraft-mounted Radars.* We will permit the use of aircraft-mounted radar applications in the entire 76-81 GHz band as long as they are used in airport air operations areas while aircraft are on the ground. For these purposes, aircraft includes helicopters, as suggested by Rockwell Collins, Inc. (Rockwell) in comments to this proceeding.[165] These radars, which have also been referred to as "wingtip radars," would be used to prevent and mitigate the severity of aircraft wingtip collisions while planes move between airport gates and runways. Aircraft wingtip collisions account for approximately 25 percent of all aircraft ground accidents, and involve substantial costs, both in terms of repairs to aircraft and ground facilities, and in lost time for passengers due to flight delays and cancellations.[166] We agree that aircraft-mounted radar applications can help protect aircraft during taxiing and ground maneuvering, improve airport operations, and provide significant benefits to the airline industry and traveling public, while still protecting vehicular radars from harmful interference.

48. Several commenters support the use of aircraft-mounted radars on the ground at airport locations on the basis that they would not pose any interference issues to vehicular radars and can coexist with FOD detection radars.[167] Delphi argues that use of aircraft-mounted radars in the 76-81 GHz band while aircraft are stationary or taxiing should not pose any major interference problems to vehicular radars.[168] Bosch contends that because there is substantial geographic separation between airport taxiways and public roads, and since aircraft-mounted radars are moving objects as are automobiles, there is no significant likelihood of interference from aircraft-mounted radars to vehicular radars.[169] Xsight argues that because of the FOD detection radar system architecture, the transient nature of aircraft-

[163] *See NPRM*, 30 FCC Rcd at 1639, para. 49; *see also* Xsight Comments at 4 (grandfathering of existing FOD detection radars will allow for the continued operations of currently deployed FOD detection systems). Any changes for previously certified FOD detection devices will need to comply with the applicable Part 95 rules. *See generally* 47 CFR § 2.1043.

[164] *See* 5 U.S.C. § 553(d)(3) (providing an exception to the required 30 days after Federal Register publication for the effectiveness of a rule when there is good cause published with the rule).

[165] Rockwell Collins, Inc. Comments at 1 (Rockwell Comments) (suggesting that in line with permitting aircraft-mounted radars, the Commission also should authorize the use of helicopter-mounted radar systems).

[166] *See NPRM*, 30 FCC Rcd at 1641, para. 57 (citing Honeywell International, Inc. Reply to Oppositions to Honeywell's Petition for Reconsideration, ET Docket No. 10-28, at 2).

[167] *See* Delphi Comments at 2, 4; *see also* Xsight Comments at 5 (agreeing with the Commission's conclusion that "it may be possible to create time and space separation" between FOD detection radar and aircraft-mounted radar application uses, which "may promote compatibility between the two operations") (quoting *NPRM*, 30 FCC Rcd at 1642, para. 59).

[168] *See* Delphi Comments at 2.

[169] *See* Bosch Reply at 26.

mounted radar operations, and the use of this radar application in gate areas and on an airport's taxiways, aircraft-mounted radars can coexist with FOD detection radars in the same airport environment.[170]

49. CEA is less certain about the use of aircraft-mounted radars on the ground, contending that "there is insufficient record to support expanding the use of aircraft-mounted radars on the ground," and such radars "are likely to interfere with vehicular radar applications" unless "there is a clear path to keeping the power of such applications out of roadways."[171] We believe we have set forth the clear path that CEA portends: aircraft-mounted radar use will be restricted to air operations areas of airports – areas that have no public vehicle access. Similar to FOD detection radars, aircraft-mounted radars operating only in airport air operations areas will have sufficient geographic separation from public roads to mitigate the potential for aircraft-mounted radars to interfere with vehicular radars. Moreover, any interference to nearby vehicular radars would require an extremely unlikely confluence of factors: even if a wingtip radar was in close enough proximity to a vehicle to avoid signal attenuation, the wingtip radar signal would have to be transmitted at an angle that illuminates the roadway area, the aircraft would have to be in a particular place long enough for interference to be realized, and site-specific features – such as airport fencing – would have to insufficiently mitigate potential interference. We further note that the public benefits of such radars are clear: these operations will have a significant impact on air traffic operations because they will assist in avoiding ground collisions between aircraft, and between aircraft and stationary objects (including service vehicles) on the airport grounds, particularly given the projections of growth in airport use.[172] As air travel grows and as larger aircraft are added to the airlines' fleets, airports will become more congested, and thus, the potential for accidents will increase.

50. We will not permit use of aircraft-mounted radars when the aircraft is airborne, based on the potential for airborne radar operations to interfere with RAS operations. Although NRAO acknowledges that there are no obvious examples of U.S. millimeter-wave RAS sites that would be affected by the surface use of wingtip radars at airport locations,[173] both NRAO and CORF strongly oppose the airborne use of such radars because airborne emissions can be particularly serious sources of interference to radio astronomy operations, given the impossibility of shielding airborne wingtip radar transmissions and the great range of visibility of aircraft in flight.[174] Such reasoning also applies to helicopter-mounted radars when the helicopter is airborne. Rockwell envisions systems that would be used "in environments where a helicopter is most likely to encounter obstacles, particularly at low altitudes during take-off, landing, and hovering scenarios."[175] Accommodating Rockwell's proposal would be inconsistent with our decision to prohibit airborne radar use. However, to the extent that there is a need to operate a radar while the helicopter is on the ground at an airport location, the rules we adopt would permit such use.[176]

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[170] Xsight Comments at 5.

[171] CEA Reply at 8-9.

[172] In 2015, PricewaterhouseCoopers forecast that air travel and aircraft demand will more than double in the next 20 years (*see* PWC *Tailwinds*, Spotlight: Managing Growth in the Rapidly Expanding Aviation Industry at 9 (June 2015), http://www.pwc.com/us/en/industrial-products/publications/pwc-tailwinds-rising-passenger-demand.html), and the FAA announced that U.S. airlines will carry 1.14 billion passengers annually by 2035, an increase of about 50 percent from 2014 levels (*see* Reuters, US Airline Passengers Forecast to Grow 50 Percent by 2035: Report (Mar. 16, 2015), http://www.reuters.com/article/2015/03/16/us-airlines-demand-idUSKBN0MC27720150316).

[173] *See* NRAO Comments at 10.

[174] NRAO Comments at 10; CORF Comments at 5-6.

[175] Rockwell Comments at 6.

[176] We recognize that there are situations where helicopters can be moved on the ground at airports. They can be equipped with wheels or a special set of 'dolly wheels' that are specifically fitted for skids. A helicopter may be pushed or pulled with a small tug to wherever it is required. Helicopters on wheels also can taxi on the ground.

51. The Commission also sought comment in the *NPRM* on whether it would be feasible to employ an automatic shut-off mechanism for aircraft-mounted radars that would prevent radar operations any time the aircraft is not on the ground.[177] CORF argues for such an automatic shut-off feature, given the likelihood of serious interference to RAS operations from airborne use of those radars.[178] Moreover, while no commenters objected to an auto-shutoff mechanism for aircraft-mounted radars, Rockwell indicated that an auto-shutoff mechanism is technically feasible.[179] We find that an automatic shut-off mechanism can offer greater assurance that parties will comply with our ground-based use restriction for aircraft-mounted radars, and that it is both feasible and desirable to deploy this feature.[180] In contrast to our decision not to require an automatic or manual shut-off for vehicular radars,[181] the risk here is greater given the potential interference to the RAS from airborne radars, and based on the record, it is feasible to include such capability for systems that will be deployed aboard aircraft. Hence, we will require that aircraft-mounted radars include an automatic mechanism that discontinues all 76-81 GHz radar functions while the aircraft is airborne.[182]

D. Radar Operations in the 76-81 GHz Band Under Part 95 of the Commission's Rules

1. Licensing

52. Currently, radar operations are authorized under Part 15 or Part 90 of the Commission's rules. As proposed in the *NPRM*, we consolidate the 76-81 GHz radar operations under Part 95, to be licensed-by-rule and protected from interference.[183] Radar applications operating in the 76-81 GHz range will now be governed by Subpart M, The 76-81 GHz Band Radar Service, in Part 95 of our rules.[184]

53. The majority of commenters overwhelmingly support the proposal to consolidate radar operations in the 76-81 GHz band under Part 95 (licensed-by-rule) instead of Part 90 (individually licensed) or Part 15 (unlicensed).[185] Delphi recognizes that the added level of interference protection Part 95 provides over Part 15 will be beneficial to the future of vehicular radars.[186] Similarly, Mercedes-Benz

[177] *NPRM*, 30 FCC Rcd at 1642, para. 60.

[178] *See* CORF Comments at 5-6.

[179] Rockwell Comments at 7 ("radar detection systems would automatically switch off when the airspeed of the [aircraft] exceeds a pre-defined value").

[180] Unlike automobiles and other vehicles, for which we are not requiring an automatic radar on/off mechanism to protect RAS facilities, commercial aircraft are substantially more expensive and much less ubiquitous, and the trigger for shut-off is based on a single objective consideration (i.e., whether the aircraft has left the ground); thus the overall cost considerations associated with an automatic radar shut-off mechanism are vastly different. Moreover, given that aircraft are not bound to roads and can be flown anywhere, we believe that the potential benefits associated with an automatic shut-off are greater in the aircraft-mounted radar context.

[181] *See supra* para. 23.

[182] *See* Appendix A to this *Report and Order* at § 95.3333.

[183] *NPRM*, 30 FCC Rcd at 1636-37, 1638-39, paras. 38-39, 46.

[184] An exception is Level Probing Radars (LPRs), which will remain authorized to operate on an unlicensed basis. We previously concluded that LPRs (which are authorized by Section 15.256 of the rules to operate in a variety of frequency ranges, including the 75-85 GHz band) can coexist with vehicular radar operations, and the *NPRM* did not propose rules that would have allowed LPRs to operate under Part 95. *See NPRM*, 30 FCC Rcd at 1631, para. 23.

[185] *See*, *e.g.*, Alliance Comments at 2; ASC Comments at 3; Delphi Comments at 1; Automotive Group Comments at 8-9; UATC Jan. 2016 *Ex Parte* at 1.

[186] Delphi Comments at 1.

and CEA note that vehicular radars will benefit from the increased level of interference protection afforded as a Part 95 service, especially considering the advent of autonomously driven vehicles.[187]

54. The benefits of a licensed-by-rule approach under our Part 95 rules are two-fold. First, Part 95 will offer a level of interference protection to 76-81 GHz band radar operations that the Part 15 rules cannot provide.[188] Whereas under Part 15, unlicensed users must accept interference from licensed and unlicensed users, under Part 95, primary licensed users are protected from interference from secondary and unlicensed users.[189] Second, a singular licensing model under Part 95 will reduce the application and licensing burdens associated with authorizing radar operations under an individual license model (such as the Part 90 service rules for FOD detection radars at 78-81 GHz), and create time and cost efficiencies for deployment of these important services.[190] As Mercedes-Benz notes, such a licensing model will also result in fewer obstacles and greater flexibility for original equipment manufacturers in developing innovative new safety features.[191]

55. Several commenters object to using a Part 95 licensed-by-rule approach for FOD detection radars in the 76-81 GHz band because the nature of the licensed-by-rule approach does not include a coordination requirement to safeguard against potential interference to other operations in the band. The Automotive Group is concerned that without site-based licensing of FOD detection radars under Part 90, there will not be a reliable way of determining whether such radars are located far enough from roads to ensure that they will not cause harmful interference to vehicular radars.[192] CORF contends that because FOD detection radars operating under Part 95 would not have to be coordinated with Federal Government users such as RAS,[193] and would no longer be operating as Part 15 unlicensed devices (which must cease operation if they cause harmful interference), we might create disincentives for operators in this band to be good spectral neighbors.[194] We find these concerns unwarranted. Currently there are no FOD detection radar operations licensed under Part 90,[195] and the Part 90 rules already

[187] *See* Mercedes-Benz Comments at 3 (noting that the Part 95 interference protection "reflects the importance of the undisturbed operation of automotive radars for the safety of vehicles and passengers that will increase with autonomously driving vehicles"); CEA Reply at 6-7 ("[t]he increased level of interference protection will undoubtedly benefit future vehicular radar deployment, which will only increase with increasingly autonomously driving vehicles").

[188] *NPRM*, 30 FCC Rcd at 1636, para. 38.

[189] *See* 47 CFR §§ 2.105(c)(2)(i), 15.5(b).

[190] *See* Alliance Comments at 2-3; CEA Reply at 7; Mercedes-Benz Comments at 3.

[191] Mercedes-Benz Comments at 3.

[192] *See* Automotive Group Comments at 16.

[193] Coordination with the Federal Government takes place through the Interdepartment Radio Advisory Committee (IRAC), an interagency committee that assists the Assistant Secretary of Commerce in assigning frequencies to U.S. Government agencies and in developing and executing policies, programs, procedures, and technical criteria pertaining to the allocations, management, and use of the electromagnetic spectrum. *See also 78-81 GHz FOD Detection Radar R&O*, 28 FCC Rcd at 10425-26, paras. 8-9 (discussing coordination of Part 90 FOD detection radar license applications with IRAC to mitigate potential interference to RAS observatories).

[194] *See* CORF Comments at 10-11.

[195] The Commission established the rules allowing FOD detection radars to be licensed under Part 90 in 2013, but did not promulgate technical specifications. *See 78-81 GHz FOD Detection Radar R&O*, 28 FCC Rcd at 10427, para. 11. The Commission stated that until such technical specifications or other rules are adopted, it would evaluate requests for equipment authorization of devices on a case-by-case basis. *Id.* A License Search of the Commission's Universal Licensing System database for Part 90 radar licenses in the 78-81 GHz band reveals there are no authorized Part 90 FOD detection radar licenses.

exempt any FOD detection radars that would be licensed from coordination with other Part 90 services.[196] As a practical matter, all existing FOD detection radar operations are taking place in the 76-77 GHz band on an unlicensed basis under our Part 15 rules without a coordination requirement, and the Commission has not received any reports of harmful interference from these FOD detection radars to vehicular radars. Nor has the Commission received reports of harmful interference from these FOD detection radars to RAS operations, particularly since the two RAS facilities currently observing in the 76-81 GHz band are located in remote areas far from airports. Given that operations of FOD detection radars will be restricted to airport air operations areas that do not have public vehicular access, and considering the narrow beamwidths, highly directional antennas, and large signal propagation losses at relatively short distances of radar operations in the 76-81 GHz band, we see no need to impose any requirement that licensed FOD detection radars begin coordinating with other licensed services, and thus, see no need to exclude FOD detection radars from Part 95 regulation.[197]

2. Technical Rules

56. Part 95 will include technical rules for radar operations in the 76-81 GHz band. As proposed in the *NPRM*, we adopt technical specifications for the newly expanded radar band that mirror those currently provided for vehicular radars and FOD detection radars in the 76-77 GHz band under the Part 15 rules.[198] Specifically, we adopt the same average (50 dBm) and peak (55 dBm) EIRP emissions limits for radar applications in the entire 76-81 GHz band as currently specified in our Part 15 rules for unlicensed vehicular radars in the 76-77 GHz band.[199] We also adopt other technical rules for the newly expanded radar band that mirror those currently provided under Part 15, including unwanted emissions limits.[200] These EIRP and unwanted emissions limits are low enough to allow for continued operations of incumbent services in the 76-81 GHz band because Part 15 vehicular and FOD detection radars in the 76-77 GHz band have been operating under these rules since 2012 without any reports of harmful interference from incumbents in the same band.[201] Moreover, the technical rules we are establishing under Part 95 for all 76-81 GHz radar operations in this *Report and Order* will facilitate coexistence between these radar services and other authorized services without imposing excessive coordination, application, or licensing burdens.

57. Vehicular radars currently certified under Part 15 to operate in the 76-77 GHz band need not be re-certified under Part 95 to continue to operate in that band. Similarly, FOD detection radars currently certified under Part 15 to operate in the 76-77 GHz band need not be re-certified under Part 95. These devices may continue their operations, but will now do so on a licensed-by-rule basis and be

[196] *See* 47 CFR § 90.175(j)(6).

[197] *See* CEA Reply at 7 (noting that since FOD detection radars are unlikely to interfere with vehicular radars, both radar applications should be consolidated in a similar licensing regime under Part 95).

[198] *See NPRM*, 30 FCC Rcd at 1644, para. 67-68.

[199] ASC supports the proposal to maintain emissions levels at the current requirements. ASC Comments at 3. Delphi agrees that the Commission should allow vehicular radars to operate anywhere within the 76–81 GHz bands with the same emissions limits as those currently specified for radar devices that operate under Part 15 of the Commission's rules. Delphi Comments at 1.

[200] In addition to rules regarding EIRP limits and unwanted emissions limits, we adopt rules on equipment certification and RF exposure evaluation. *See* Appendix A to this *Report and Order* (Final Rules).

[201] *See 2012 Radar R&O*, 27 FCC Rcd at 7888, para. 24. *But see* NRAO Comments at 10 (requesting that, as compared to the Commission's current rules, vehicular radars' unwanted emissions should be: limited to the ETSI standards; more strongly confined in frequency; and investigated over a larger frequency range). NRAO does not claim that these suggested rule modifications are in response to any particular case of harmful interference.

entitled to interference protection from amateur operations in the 76-77 GHz band. However, any changes for such previously certified devices will need to comply with the applicable Part 95 rules.[202]

58. Our new Part 95 radar rules do not establish distinct spectrum blocks in the 76-81 GHz band for particular radar applications such as LRR and SRR, or FOD detection and aircraft-mounted radars. Instead, we will rely on market forces and standardization processes to drive the use of the band in accordance with application needs and the state of technology. Although the Commission recognized in the *NPRM* an apparent industry consensus on locating SRR applications in the newly expanded frequencies at 77-81 GHz, while retaining LRR use of the 76-77 GHz segment, it did not propose to designate specific portions of the band for SRR and LRR use.[203] Delphi argues against differentiating between LRR and SRR applications, allowing both types of vehicular radars to operate anywhere within the 76–81 GHz band with the same emissions regulations as currently specified for LRR devices operation under Part 15.[204] On the other hand, Bosch states that because sharing studies indicate that frequency sharing between SRR and LRR systems is not possible, we should separate LRR and SRR operations.[205] Similarly, Xsight states that, although it expects FOD detection and aircraft-mounted radars to be able to coexist without causing interference to each other, it suggests that the Commission could take extra precautions by designating a different one gigahertz frequency range (e.g., 80-81 GHz) for aircraft-mounted radar applications.[206]

59. We find it unnecessary to define and distinguish LRR and SRR use within our rules. Unlike some fixed radar applications (e.g., roadside traffic monitoring) that have the potential to cause harmful interference to vehicular radar operations in many instances and warrant exclusion from operation in the 76-81 GHz band until their compatibility with vehicular radar operations can be assured,[207] the compatible characteristics of vehicular radars operating in the 76-81 GHz band will allow interested parties to determine whether particular segments of the 76-81 GHz band should be designated exclusively for LRR or SRR applications. Vehicular radar operations involve low-power, short-range transmissions with multiple shared channels where users can avoid congestion fairly easily.[208] This approach is particularly apt here, especially given our expectations that vehicular radars will be the most predominant and widespread use of the band. Automotive equipment manufacturers have a strong incentive to ensure the successful deployment of vehicular radar technologies and have demonstrated an ability to work cooperatively through their unified efforts to make the 76-81 GHz band available for vehicular radars on a worldwide harmonized basis.[209] Moreover, by taking a light-handed regulatory approach, we will maintain manufacturers' flexibility in designing and manufacturing vehicular radars and make it easier for vehicular radar manufacturers to optimize LRR and SRR operations within the

[202] *See generally* 47 CFR § 2.1043.

[203] *See NPRM*, 30 FCC Rcd at 1637, para. 40.

[204] *See* Delphi Comments at 1.

[205] *See* Bosch Comments at 7; *see also* UATC Jan. 2016 *Ex Parte* at 1-2 (suggesting that if the Commission assigned LRRs to specific frequencies, it could more easily consider different technical requirements for LRRs at a later time); Letter from Thomas Cohen, Counsel for Trex Enterprises Corp., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 15-26, attached presentation at 11 (filed Nov. 23, 2015) (supporting restriction of LRR operations to the 76-77 GHz band).

[206] *See* Xsight Comments at 5, n.14 (citing *NPRM*, 30 FCC Rcd at 1643, para. 61 (seeking comment on allowing wingtip radars to operate with a bandwidth of one gigahertz over various portions of the 76-81 GHz band)).

[207] *See supra* Section III.C.1.

[208] *See* Automotive Group Comments at 8-9.

[209] According to Bosch, parties worldwide have engaged for several years in a comprehensive effort to standardize vehicular radar operations at 76-81 GHz. *See* Bosch Reply at 10.

band as warranted by the development of future innovative vehicular radar applications, which, in turn, will further lessen the potential for interference between these applications.

60. We apply the same analysis to the question of spectrum use by aircraft-mounted radars in the 76-81 GHz band. FOD detection and aircraft-mounted radar operations both involve low power short range transmissions with multiple shared channels where users can avoid congestion fairly easily. Allowing an aircraft-mounted, FOD detection, or any other airport-based radar to operate anywhere within the entirety of the 76-81 GHz band will allow the industry, market forces, and standards bodies to optimize use of the band and determine whether particular segments of the 76-81 GHz band should be designated exclusively for aircraft-mounted radar or FOD detection radar use to further lessen the potential for interference between these applications. This is particularly appropriate for the airport setting, which is already highly coordinated and controlled to ensure safe and efficient operations. In addition, our approach will serve the public interest since it will maintain manufacturers' flexibility in designing and manufacturing radars for use on airport grounds. Therefore, we find it unnecessary to restrict the use of aircraft-mounted radars to a one gigahertz block of spectrum within the 76-81 GHz band.

IV. PROCEDURAL MATTERS

A. Final Regulatory Flexibility Analysis

61. As required by the Regulatory Flexibility Act of 1980 (RFA),[210] the Commission has prepared a Final Regulatory Flexibility Analysis (FRFA) for this *Report and Order*. The FRFA is set forth in Appendix B.

B. Paperwork Reduction Analysis

62. This document does not contain new or modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. In addition, therefore, it does not contain any new or modified information collection burden for small business concerns with fewer than 25 employees, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. § 3506(c)(4).

C. Congressional Review Act

63. The Commission will send a copy of this *Report and Order* in ET Docket No. 15-26 to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. 801(a)(1)(A).

D. Further Information

64. For further information regarding this *Report and Order*, please contact Howard Griboff, at (202) 418-0657/ Howard.Griboff@fcc.gov, or Patrick Forster at (202) 418-7061/ Patrick.Forster@fcc.gov, Office of Engineering and Technology, Federal Communications Commission, 445 12th Street, S.W., Washington, DC 20554.

V. ORDERING CLAUSES

65. IT IS ORDERED that pursuant to Sections 1, 2, 4(i), 301, 302(a), and 303(f) of the Communications Act of 1934, 47 U.S.C. §§ 151, 152, 154(i), 301, 302(a), and 303(f), this *Report and Order* in ET Docket No. 15-26 IS ADOPTED.

66. IT IS FURTHER ORDERED that Parts 1, 2, 15, 90, 95, and 97 of the Commission's Rules, 47 C.F.R. Parts 1, 2, 15, 90, 95, and 97 ARE AMENDED as specified in Appendix A, effective on a date ("Effective Date") that is 30 days after publication in the Federal Register.

[210] *See* 5 U.S.C. § 604.

67. IT IS FURTHER ORDERED that, pursuant to the authority contained in Sections 4(i), 4(j), and 303 of the Communications Act, as amended, 47 U.S.C. §§ 154(i), 154(j) and 303, that ET Docket No. 15-26 IS CLOSED and the proceeding is TERMINATED, should no petitions for reconsideration, applications for review, or petitions for judicial review be timely filed.

68. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of the *Report and Order* in ET Docket No. 15-26, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

69. IT IS FURTHER ORDERED that the Commission SHALL SEND a copy of this *Report and Order* to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. § 801(a)(1)(A).

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

Final Rules

For the reasons set forth in the preamble, the Federal Communications Commission amends Parts 1, 2, 15, 90, 95, and 97 of Title 47 of the Code of Federal Regulations as follows:

PART 1 – PRACTICE AND PROCEDURE

1. The authority citation for part 1 continues to read as follows:

Authority: 47 U.S.C. 151, 154(i), 154(j), 155, 157, 160, 201, 225, 227, 303(r), 309, 332, 1403, 1404, 1451, 1452, and 1455.

2. Amend Section 1.1307 by adding an entry for "76-81 GHz Radar Service (part 95)" above the entry for "Amateur Radio Service (part 97)" in Table 1 in paragraph (b)(1) and revising paragraphs (b)(2)(i) and (ii) to read as follows:

§ 1.1307 Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.

* * * * *

(b) * * *

(1) * * *

Table 1 – Transmitters, Facilities and Operations Subject to Routine Environmental Evaluation

Service (title 47 CFR rule part)	Evaluation required if:
* * * * *	
76-81 GHz Radar Service (part 95)	All included.
* * * * *	

(2)(i) Mobile and portable transmitting devices that operate in the Commercial Mobile Radio Services pursuant to part 20 of this chapter; the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Services (PCS) pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Upper Microwave Flexible Use Service pursuant to part 30 of this chapter; the Maritime Services (ship earth stations only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, the 4.9 GHz Band Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; the Wireless Medical Telemetry Service (WMTS), the Medical Device Radiocommunication Service (MedRadio), and the 76-81 GHz Band Radar Service pursuant to part 95 of this chapter; and the Citizens Broadband Radio Service pursuant to part 96 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use, as specified in §§ 2.1091 and 2.1093 of this chapter.

(ii) Unlicensed PCS, unlicensed NII, and millimeter-wave devices are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use, as specified in §§ 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter.

* * * * *

PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS

3. The authority citation for part 2 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

4. Amend Section 2.106, the Table of Frequency Allocations, as follows:

a. Page 62 is revised.

b. Under "International Footnotes," add, in numerical order, footnote 5.559B.

The revision and addition read as follows:

§ 2.106 Table of Frequency Allocations.

* * * * *

76-77.5 RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149	76-81 RADIO ASTRONOMY RADIOLOCATION Space research (space-to-Earth)	76-77 RADIO ASTRONOMY RADIOLOCATION Amateur Space research (space-to-Earth) US342	RF Devices (15) Personal Radio (95) Amateur Radio (97)
77.5-78 AMATEUR AMATEUR-SATELLITE RADIOLOCATON 5.559B Radio astronomy Space research (space-to-Earth) 5.149		77-81 RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth)	
78-79 RADIOLOCATION Amateur Amateur-satellite Radio astronomy Space research (space-to-Earth) 5.149 5.560			
79-81 RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149	5.560 US342	5.560 US342	
81-84 FIXED 5.338A FIXED-SATELLITE (Earth-to-space) MOBILE MOBILE-SATELLITE (Earth-to-space) RADIO ASTRONOMY Space research (space-to-Earth) 5.149 5.561A	81-84 FIXED FIXED-SATELLITE (Earth-to-space) US297 MOBILE MOBILE-SATELLITE (Earth-to-space) RADIO ASTRONOMY Space research (space-to-Earth) US161 US342 US389		RF Devices (15) Fixed Microwave (101)
84-86 FIXED 5.338A FIXED-SATELLITE (Earth-to-space) 5.561B MOBILE RADIO ASTRONOMY 5.149	84-86 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE RADIO ASTRONOMY US161 US342 US389		Page 62

* * * * *

INTERNATIONAL FOOTNOTES

* * * * *

5.559B The use of the frequency band 77.5-78 GHz by the radiolocation service shall be limited to short-range radar for ground-based applications, including automotive radars. The technical characteristics of these radars are provided in the most recent version of Recommendation ITU-R M.2057. The provisions of No. 4.10 do not apply. (WRC-15)

* * * * *

5. Amend Section 2.1091 by revising paragraphs (c)(1) introductory text and (c)(2) to read as follows:

§ 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.

* * * * *

(c)(1) Mobile devices that operate in the Commercial Mobile Radio Services pursuant to part 20 of this chapter; the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Services pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Upper Microwave Flexible Use Service pursuant to part 30 of this chapter; the Maritime Services (ship earth station devices only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; the 76-81 GHz Band Radar Service pursuant to part 95 of this chapter; and the Citizens Broadband Radio Service pursuant to part 96 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if:

(i) * * *

(ii) * * *

(2) Unlicensed personal communications service devices, unlicensed millimeter-wave devices, and unlicensed NII devices authorized under §§ 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if their ERP is 3 watts or more or if they meet the definition of a portable device as specified in §2.1093(b) requiring evaluation under the provisions of that section.

6. Amend Section 2.1093 by revising paragraph (c)(1) to read as follows:

§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices.

* * * * *

(c)(1) Portable devices that operate in the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Service (PCS) pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Upper Microwave Flexible Use Service pursuant to part 30 of this chapter; the Maritime Services (ship earth station devices only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, the 4.9 GHz Band Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; the Wireless Medical Telemetry Service (WMTS), the Medical Device Radiocommunication Service (MedRadio), and the 76-81 GHz Band Radar Service pursuant to subparts H, I, and M of part 95 of this chapter, respectively; unlicensed personal communication service, unlicensed NII devices and millimeter-wave devices authorized under §§ 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter; and the Citizens Broadband Radio Service

pursuant to part 96 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use.

* * * * *

PART 15 – RADIO FREQUENCY DEVICES

7. The authority citation for Part 15 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, 304, 307, 336, 544a and 549.

8. Amend Section 15.37 by adding paragraphs (l) through (p) to read as follows:

§ 15.37 Transition provisions for compliance with the rules.

* * * * *

(l) The certification of wideband vehicular radars designed to operate in the 23.12-29 GHz band under § 15.252 and ultra-wideband vehicular radars designed to operate in the 22-29 GHz band under § 15.515 shall not be permitted on or after [INSERT DATE ONE YEAR AFTER DATE OF FEDERAL REGISTER PUBLICATION].

(m) The manufacture, importation, marketing, sale, and installation of wideband or ultra-wideband vehicular radars that are designed to operate in the 23.12-29 GHz band under § 15.252 and/or in the 22-29 GHz band under § 15.515 shall not be permitted after January 1, 2022. Notwithstanding the foregoing, sale and installation of such radars is permitted, for the life of the vehicle, when the following conditions have been met:

(1) The sale and installation is for the exclusive purpose of repairing or replacing defective, damaged, or potentially malfunctioning radars that are designed to operate in the 23.12-29 GHz band under § 15.252 and/or in the 22-29 GHz band under § 15.515;

(2) The equipment being repaired or replaced has been installed in the vehicle on or before January 1, 2022; and

(3) It is not possible to replace the vehicular radar equipment designed to operate in the 23.12-29 GHz and/or 22-29 GHz bands with vehicular radar equipment designed to operate in the 76-81 GHz band.

(n) Wideband or ultra-wideband vehicular radars operating in the 23.12-29 GHz band under § 15.252 and/or in the 22-29 GHz band under § 15.515 that are already installed or in use may continue to operate in accordance with their previously obtained certification. Class II permissive changes for such equipment shall not be permitted after January 1, 2022.

(o) Applicable July 13, 2017, the certification, manufacture, importation, marketing, sale, and installation of field disturbance sensors that are designed to operate in the 16.2-17.7 GHz and 46.7-46.9 GHz bands shall not be permitted. Field disturbance sensors already installed or in use in the 16.2-17.7 GHz band may continue to operate in accordance with their previously obtained certification. Class II permissive changes shall not be permitted for such equipment.

(p) Effective [INSERT DATE 30 DAYS AFTER DATE OF FEDERAL REGISTER PUBLICATION], the certification under this part of vehicular radars and fixed radar systems used in airport air operations areas that are designed to operate in the 76-77 GHz band shall not be permitted. Vehicular radars and fixed radar systems used in airport air operations areas operating in the 76-77 GHz band that are already installed or in use may continue to operate in accordance with their previously obtained certification.

Any future certification, or any change of already issued certification and operations of such equipment, shall be under Part 95, Subpart M, of this chapter.

* * * * *

9. Amend Section 15.252 by revising the section heading and paragraphs (a) introductory text and (a)(1), removing paragraph (b)(1), redesignating paragraphs (b)(2) through (6) as paragraphs (b)(1) through (5), revising newly redesignated paragraphs (b)(2) and (3), and adding paragraph (d) to read as follows:

§ 15.252 Operation of wideband vehicular radar systems within the band 23.12-29.0 GHz.

(a) Operation under this section is limited to field disturbance sensors that are mounted in terrestrial transportation vehicles. Terrestrial use is limited to earth surface-based, non-aviation applications.

(1) The -10 dB bandwidth of the fundamental emissions shall be located within the 23.12-29.0 GHz band, exclusive of the 23.6-24.0 GHz restricted band, as appropriate, under all conditions of operation including the effects from stepped frequency, frequency hopping or other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

* * * * *

(b) * * *

(2) In addition to the radiated emissions limits specified in the table in paragraph (b)(1) of this section, transmitters operating under the provisions of this section shall not exceed the following RMS average EIRP limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	−85.3
1559-1610	−85.3

(3) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs and this 50 MHz bandwidth must be contained within the 24.05-29.0 GHz band. The peak EIRP limit is 20 log (RBW/50) dBm where RBW is the resolution bandwidth in MHz employed by the measurement instrument. RBW shall not be lower than 1 MHz or greater than 50 MHz. Further, RBW shall not be greater than the -10 dB bandwidth of the device under test. For transmitters that employ frequency hopping, stepped frequency or similar modulation types, measurement of the -10 dB minimum bandwidth specified in this paragraph shall be made with the frequency hop or step function disabled and with the transmitter operating continuously at a fundamental frequency. The video bandwidth of the measurement instrument shall not be less than RBW. The limit on peak emissions applies to the 50 MHz bandwidth centered on the frequency at which the highest level radiated emission occurs. If RBW is greater than 3 MHz, the application for certification shall contain a detailed description of the test procedure, the instrumentation employed in the testing, and the calibration of the test setup.

* * * * *

(d) Wideband vehicular radar systems operating in the 23.12-29.0 GHz band are subject to the transition provisions of § 15.37(l) through (n).

10. Remove and reserve Section 15.253.

§ 15.253 [Removed and Reserved]

11. Amend Section 15.515 by adding paragraph (h) to read as follows:

* * * * *

(h) UWB vehicular systems operating in the 22-29 GHz band are subject to the transition provisions of § 15.37(l) through (n).

PART 90 – PRIVATE LAND MOBILE RADIO SERVICES

12. The authority citation for Part 90 continues to read as follows:

Authority: Sections 4(i), 11, 303(g), 303(r), and 332(c)(7) of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 161, 303(g), 303(r), and 332(c)(7), and Title VI of the Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. 112-96, 126 Stat. 156.

13. Amend Section 90.103 by removing the entry "78,000-81,000" in the table in paragraph (b).

PART 95 – PERSONAL RADIO SERVICES

14. Add Subpart M to the Table of Contents of Part 95 to read as follows:

Subpart M – The 76-81 GHz Band Radar Service

ADMINISTRATIVE RULES

Sec.
95.3301 Scope.
95.3303 Definitions, The 76-81 GHz Band Radar Service.
95.3305 Radar operator eligibility in the 76-81 GHz Band**.**

OPERATING RULES

95.3331 Permissible 76-81 GHz Band Radar Service uses.
95.3333 Airborne use of 76-81 GHz Band Radar Service is prohibited.
95.3347 76-81 GHz Band Radar Service automatic control.

TECHNICAL RULES

95.3361 Certification.
95.3367 76-81 GHz Band Radar Service radiated power limits.
95.3379 76-81 GHz Band Radar Service unwanted emissions limits.
95.3385 76-81 GHz Band Radar Service RF exposure evaluation.

15. The authority citation for Part 95 continues to read as follows:

Authority: 47 U.S.C. 154, 301, 302(a), 303, and 307(e).

16. Revise Section 95.347 to read as follows:

§ 95.347 Automatic control.

Operation of Personal Radio Services stations under automatic control is prohibited, unless otherwise allowed for a particular Personal Radio Service by rules in the subpart governing that specific service.

See, e.g., §§ 95.1747, 95.2347, 95.2547, 95.3347.

17. Add Subpart M, consisting of Sections 95.3301 through 95.3385, to read as follows:

Subpart M – The 76-81 GHz Band Radar Service

ADMINISTRATIVE RULES

§ 95.3301 Scope.

This subpart sets out the regulations that apply to radar systems operating in the 76-81 GHz band. This subpart does not apply to Level Probing Radars that operate under part 15 of this title.

§ 95.3303 Definitions, the 76-81 GHz Band Radar Service.

Air operations area. See § 87.5 of this chapter.

Field disturbance sensor. See § 15.5(l) of this chapter.

Foreign object debris (FOD) detection radar. A radar device designed to detect foreign object debris in airport air operations areas and to monitor aircraft as well as service vehicles on taxiways, and other airport vehicle service areas that have no public vehicle access.

Radar. See § 2.1(c) of this chapter.

§ 95.3305 Radar operator eligibility in the 76-81 GHz Band.

Subject to the requirements of §§ 95.305 and 95.307, any person is eligible to operate a radar in the 76-81 GHz band without an individual license; such operation must comply with all applicable rules in this subpart.

OPERATING RULES

§ 95.3331 Permissible 76-81 GHz Band Radar Service uses.

Radar systems operating in the 76-81 GHz band may operate as vehicular radars, or as fixed or mobile radars in airport air operations areas, including but not limited to FOD detection radars and aircraft-mounted radars for ground use only.

§ 95.3333 Airborne use of 76-81 GHz Band Radar Service is prohibited.

Notwithstanding the provisions of § 95.3331, 76-81 GHz Band Radar Service is prohibited aboard aircraft in flight. Aircraft-mounted radars shall be equipped with a mechanism that will prevent operations once the aircraft becomes airborne.

§ 95.3347 76-81 GHz Band Radar Service automatic control.

Notwithstanding the provisions of § 95.347, 76-81 GHz Band Radar Service operations may be conducted under manual or automatic control.

TECHNICAL RULES

§ 95.3361 Certification.

Radar equipment operating in the 76-81 GHz band shall be certificated in accordance with this subpart and subpart J of part 2 of this chapter.

§ 95.3367 76-81 GHz Band Radar Service radiated power limits.

The fundamental radiated emission limits within the 76-81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as follows:

(a) The maximum power (EIRP) within the 76-81 GHz band shall not exceed 50 dBm based on measurements employing a power averaging detector with a 1 MHz Resolution Bandwidth (RBW).

(b) The maximum peak power (EIRP) within the 76-81 GHz band shall not exceed 55 dBm based on measurements employing a peak detector with a 1 MHz RBW.

§ 95.3379 76-81 GHz Band Radar Service unwanted emissions limits.

(a) The power density of any emissions outside the 76-81 GHz band shall consist solely of spurious emissions and shall not exceed the following:

(1) Radiated emissions below 40 GHz shall not exceed the field strength as shown in the following emissions table.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

(i) In the emissions table in paragraph (a)(1) of this section, the tighter limit applies at the band edges.

(ii) The limits in the table in paragraph (a)(1) of this section are based on the frequency of the unwanted emissions and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(iii) The emissions limits shown in the table in paragraph (a)(1) of this section are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9.0-90.0 kHz, 110.0-490.0 kHz, and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector with a 1 MHz RBW.

(2) The power density of radiated emissions outside the 76-81 GHz band above 40.0 GHz shall not exceed the following, based on measurements employing an average detector with a 1 MHz RBW:

(i) For radiated emissions outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 600 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

(3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz.

(b) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

§ 95.3385 76-81 GHz Band Radar Service RF exposure evaluation.

Regardless of the power density levels permitted under this subpart, devices operating under the provisions of this subpart are subject to the radiofrequency radiation exposure requirements specified in §§ 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 97 – AMATEUR RADIO SERVICE

18. The authority citation for Part 97 continues to read as follows:

Authority: 48 Stat. 1066, 1082, as amended: 47 U.S.C. 154, 303. Interpret or apply 48 Stat. 1064-1068, 1081-1105, as amended; 47 U.S.C. 151-155, 301-609, unless otherwise noted.

19. Amend Section 97.303 by revising paragraphs (c) and (f) and removing and reserving paragraph (s) to read as follows:

§ 97.303 Frequency sharing requirements.

* * * * *

(c) Amateur stations transmitting in the 76-81 GHz segment, the 136-141 GHz segment, or the 241-248 GHz segment must not cause harmful interference to, and must accept interference from, stations authorized by the United States Government, the FCC, or other nations in the radiolocation service.

* * * * *

(f) Amateur stations transmitting in the following segments must not cause harmful interference to radio astronomy stations: 3.332-3.339 GHz, 3.3458-3.3525 GHz, 76-81 GHz, 136-141 GHz, 241-248 GHz, 275-323 GHz, 327-371 GHz, 388-424 GHz, 426-442 GHz, 453-510 GHz, 623-711 GHz, 795-909 GHz, or 926-945 GHz. In addition, amateur stations transmitting in the following segments must not cause harmful interference to stations in the Earth exploration-satellite service (passive) or the space research service (passive): 275-277 GHz, 294-306 GHz, 316-334 GHz, 342-349 GHz, 363-365 GHz, 371-389 GHz, 416-434 GHz, 442-444 GHz, 496-506 GHz, 546-568 GHz, 624-629 GHz, 634-654 GHz, 659-661 GHz, 684-692 GHz, 730-732 GHz, 851-853 GHz, or 951-956 GHz.

* * * * *

(s) [Reserved]

* * * * *

20. Amend Section 97.313 by adding paragraph (m) to read as follows:

§ 97.313 Transmitter power standards.

* * * * *

(m) No station may transmit with a peak equivalent isotropically radiated power (EIRP) exceeding 316 W in the 76-81 GHz (4 mm) band.

APPENDIX B

Final Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980, as amended (RFA),[1] an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the Amendments to Part Parts 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band, *Notice of Proposed Rulemaking and Reconsideration Order*.[2] The Commission sought written public comment on the proposals in the *NPRM*, including comment on the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.[3]

A. Need for, and Objectives of, the Proposed Rules

In this *Report and Order*, we adopt various proposals made in an *NPRM* adopted in 2015 to permit certain radar applications in the entire 76-81 GHz band, i.e., vehicular radars, and non-vehicular radars at airport locations, and we make the appropriate changes to the U.S. Table of Frequency Allocations. Given this large contiguous spectrum band we are providing for vehicular radar use, we remove vehicular radar operations from the 16.2-17.7 GHz and 46.7-46.9 GHz bands, and establish a gradual phasing out of wideband and ultra-wideband (UWB) vehicular radar operations in the 23.12-29.0 GHz band and the 22-29 GHz band, respectively. We also evaluate the compatibility of radar applications with incumbent operations in the 76-81 GHz band. Finally, we consolidate the technical rules for radar operations in the 76-81 GHz bands under Part 95. By these actions, we establish a comprehensive and consistent set of rules and policies to govern the operation of vehicular radars, and non-vehicular radar operations at airport locations, in the 76-81 GHz band.

Radar applications discussed in the *Report and Order* include:

- Vehicular radars that can determine the exact distance and relative speed of objects in front of, beside, or behind a car to improve the driver's ability to perceive objects under bad visibility conditions or objects that are in blind spots. Some examples of vehicular radar systems include collision warning and mitigation systems, blind spot detection systems, lane change assist, and parking aid systems.
- Radars that detect foreign object debris (FOD) at airports. The presence of FOD in an airport's air operations area poses a significant threat to the safety of air travel. FOD on taxiways and runways has the potential to damage aircraft during the critical phases of takeoffs and landings, which can lead to catastrophic loss of life, and at the very least, increased maintenance and operating costs.
- Aircraft-mounted radars, that are intended to prevent or mitigate the severity of aircraft wing collisions while a plane is taxiing on the tarmac. These radars are used only while aircraft are on the ground. Mitigating the risk of wingtip collisions can reduce costs and improve safety for both aviation personnel and the traveling public.

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

There were no comments filed that specifically addressed the rules and policies proposed in the IRFA.

[1] 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601 – 612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

[2] *Amendment of Parts 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band*, ET Docket No. 15-26, Notice of Proposed Rulemaking and Reconsideration Order, 30 FCC Rcd 1625 (2015) (*NPRM*).

[3] *See* 5 U.S.C. § 604.

C. Response to comments by the Chief Counsel for Advocacy of the Small Business Administration

The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

D. Description and Estimate of the Number of Small Entities to Which the Proposed Rule Will Apply

The RFA directs agencies to provide a description of, and, where feasible, an estimate of, the number of small entities that may be affected by the rules adopted herein.[4] The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[5] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[6] A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[7]

Other Communications Equipment Manufacturing. This industry comprises establishments primarily engaged in manufacturing communications equipment (except telephone apparatus, and radio and television broadcast, and wireless communications equipment). Examples of such manufacturing include fire detection and alarm systems manufacturing, Intercom systems and equipment manufacturing, and signals (e.g., highway, pedestrian, railway, traffic) manufacturing.[8] The SBA has established a size standard for this industry as 750 or fewer employees.[9] Census data for 2012 show that 383 establishments operated in that year. Of that number, 379 operated with fewer than 500 employees.[10] Based on this data, we conclude that the majority of Other Communications Equipment Manufacturers are small.

Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing. This U.S. industry comprises establishments primarily engaged in manufacturing search, detection, navigation, guidance, aeronautical, and nautical systems and instruments. Examples of products made by these establishments are aircraft instruments (except engine), flight recorders, navigational instruments and systems, radar systems and equipment, and sonar systems and equipment.[11] The SBA has established a size standard for this industry of 1,250 or fewer employees.[12] Data from the 2012 Economic Census data for 2012 show that 588 establishments operated in that year. Of that number, 533 operated with fewer than 500 employees.[13] Based on this data, we conclude that the majority of manufacturers in this industry are small.

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[4] 5 U.S.C. § 604(a)(3).

[5] 5 U.S.C. § 601(6).

[6] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small-business concern" in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

[7] 15 U.S.C. § 632.

[8] https://www.census.gov/cgi-bin/sssd/naics/naicsrch.

[9] 13 CFR § 121.201, NAICS Code 334290.

[10] http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ECN_2012_US_31SG2&prod.

[11] https://www.census.gov/cgi-bin/sssd/naics/naicsrch.

[12] 13 CFR § 121.201, NAICS Code 334511.

[13] http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ECN_2012_US_31SG2&prod.

Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing. This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.[14] The Small Business Administration has established a size standard for this industry of 750 or fewer employees.[15] Census data for 2012 show that 841 establishments operated in this industry in that year. Of that number, 819 establishments operated with fewer than 500 employees.[16] Based on this data, we conclude that a majority of manufacturers in this industry are small.

E. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

Radars operating in the 76-81 GHz band are required to be authorized under the Commission's certification procedure as a prerequisite to marketing and importation, and the rules adopted in the *Report and Order* have no impact on that requirement.

F. Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered

The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.[17]

The rules and policies the *Report and Order* are deregulatory in nature, which we expect simplifies compliance requirements for all parties, particularly small entities, and permits the development of improved radar systems. Allowing permissible radar operations to use the entire 76-81 GHz band will reduce radar equipment prices and, with regard to vehicular radars, encourage deployment of automotive radars in lower-cost vehicles. Consolidating regulation of the permissible radar applications in Part 95 of the Commission's rules, in lieu of the current patchwork of rules, generally will reduce unnecessary compliance burdens for the general public (e.g., permit operation by rule in lieu of an individual license) and will provide increased spectrum efficiency.

Report to Congress: The Commission will send a copy of the *Report and Order*, including this FRFA, in a reports to be sent to Congress pursuant to the Congressional Review Act.[18] In addition, the Commission will send a copy of the *Report and Order*, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the *Report and Order* and FRFA (or summaries thereof) will also be published in the Federal Register.[19]

[14] https://www.census.gov/cgi-bin/sssd/naics/naicsrch.

[15] 13 CFR § 121.201, NAICS Code 334220.

[16] http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ECN_2012_US_31SG2&prod.

[17] *See* 5 U.S.C. § 603(c).

[18] 5 U.S.C. § 801(a)(1)(A).

[19] *See* 5 U.S.C. § 604(b).

APPENDIX C

List of Comments

Comments

Alliance of Automobile Manufacturers, Inc.
ARRL, the national association for Amateur Radio
Automotive Safety Council
Barry Malowanchuck
Continental Automotive Systems, Inc.
Delphi Automotive Systems
Gary Lauterbach
Mantissa Ltd.
Mercedes-Benz USA, LLC
Michael Seguin
National Academy of Sciences' Committee on Radio Frequencies
National Radio Astronomy Observatory
Navtech Radar Ltd.
Nickolaus E. Leggett
Robert Bosch, LLC
Robert M. Bownes III
Robert R. Johnson
Rockwell Collins, Inc.
Ronald E. Telsch
Telecommunications Industry Association
The Former Strategic Automotive Radar Frequency Allocation Group, Caterpillar, Delphi Automotive, and General Motors Company
Thomas D. Williams
Trimble Navigation Limited
William Polewarczyk
Xsight Systems

Reply Comments

ARRL, the national association for Amateur Radio
Association of Global Automakers, Inc. (filed under Michael Cammisa)
Consumer Electronics Association
Mantissa Ltd.
Navtech Radar Ltd.
Nickolaus E. Leggett
RhiZone Inc.
Robert Bosch, LLC
Sivers IMA
The Former Strategic Automotive Radar Frequency Allocation Group, Caterpillar, Delphi Automotive, and General Motors Company
Trimble Navigation Limited

Ex Parte Comments

Alliance of Automobile Manufacturers and Association of Global Automakers
Alliance of Automobile Manufacturers, FCA US LLC, Toyota, and Mercedes-Benz USA, LLC
Alliance of Automobile Manufacturers, General Motors, FCA US LLC, Association of Global Automakers, Mercedes Benz USA, and American Honda Motor Company
Association of Global Automakers
Continental Automotive (filed under Ian Musselman)

Freeport McMoRan Inc.
General Motors Company
IDS GeoRadar
Mercedes-Benz USA, LLC
Motor & Equipment Manufacturers Association (MEMA) (filed under Leigh Merino)
National Radio Astronomy Observatory
Navtech Radar Ltd.
Robert Bosch, LLC
Rockwell Collins, Inc.
Trex Enterprises Corporation
UATC, LLC

STATEMENT OF
CHAIRMAN AJIT PAI

Re: *Amendment of Parts 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band*, ET Docket No. 15-26.

I always try to be conscious of the rules of the road. But when I'm in the car with my kids, vehicular safety becomes an all-encompassing concern. Thankfully, auto manufacturers are continuing to roll out new, proven technologies that enable services like collision avoidance, blind spot monitoring, and lane change assistance. Vehicular radar systems can improve our driving experience and help our families stay safe.

Today, the FCC does its part to promote this consumer-friendly innovation by giving these systems the bandwidth needed to operate fully and securely. By allocating a contiguous 76–81 GHz band to these services, we expand the existing 76–77 GHz allocation for vehicular radars by four gigahertz. We are also moving other vehicular radar operations from other bands to be consolidated into these frequencies. Access to this contiguous block of spectrum will allow for new innovations and the expansion of potentially life-saving vehicular radar technologies.

We also open up this band to expand access for fixed and mobile radars in airport operations areas. This could not only ensure safety, but hopefully prevent flight delays as well. For instance, according to one commenter, wingtip collisions account for approximately 25% of all aircraft ground accidents. "Wingtip radars" on aircraft may help with collision avoidance on the tarmac, among other areas.

My thanks to the staff who worked on this item: Rashmi Doshi, Patrick Forster, Howard Griboff, Matthew Hussey, Ira Keltz, Julie Knapp, Geraldine Matise, and Jamison Prime from the Office of Engineering and Technology; Tom Derenge and Scot Stone from the Wireless Telecommunications Bureau; Jeremy Marcus and Aspasia Paroutsas from the Enforcement Bureau; and David Horowitz and Anjali Singh from the Office of General Counsel. Your work impacts the lives of millions of Americans, and is vital to improving vehicular safety.

STATEMENT OF COMMISSIONER MIGNON L. CLYBURN

Re: *Amendment of Parts 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band*, ET Docket No. 15-26

The first gasoline-powered automobile driven on American soil was built by John William Lambert in 1891. Then referred to as a "horseless carriage," it drove on three wheels – with two large wheels in the rear and one smaller wheel in the front. It used a lever for steering and ran on a one-cylinder engine. According to Ohio legend, the first car accident in American history occurred that same year in Ohio City when Lambert's vehicle hit the roots of a tree stump and crashed into a hitching post. Fortunately, no one suffered major injuries, and with help, the car continued on its way.

The transportation landscape has advanced significantly since Lambert's early experiments. What has not changed, however, is the critical importance of vehicle safety. While we enthusiastically harness new technology that will ultimately propel us to a driverless future, we must maintain our focus on safety – and radar applications play an important role.

Vehicular radars serve multiple safety functions, including the ability to determine the distance and movement of objects adjacent to vehicles, which helps to improve a driver's perception in poor visibility conditions. Those of us who use adaptive cruise control or collision avoidance systems know just how important and beneficial automotive radar applications can be. And today's decision will foster even more innovation for vehicular as well as non-vehicular radar systems, such as foreign object debris detection radars on airport runways and aircraft wingtip radars.

Back in 1891, it was unlikely that Lambert could have predicted these spectacular advances in transportation. Today, we too, are limited in predicting the innovative landmarks sure to be realized over the next 10, let alone 100 years. It is my hope that this item will open the door to many exciting possibilities.

Thank you, Julie Knapp and the staff of the Office of Engineering and Technology for your important work on this item.

STATEMENT OF
COMMISSIONER MICHAEL O'RIELLY

Re: Amendment of Parts 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band, ET Docket No. 15-26, Report and Order.

I must admit that I have been more than hesitant to allocate such a large swath of spectrum to auto safety systems as the item before us does. This institution has a mixed track record when it comes to seeing such technologies come to fruition. Specifically, it is now almost two decades since the Commission allocated 5.9 GHz spectrum for dedicated short-range communications (DSRC) systems and still have little to show for it. At least in this case, the vehicular radar technology exists and is deployed. In fact, today's item consolidates all radars in one place, in the 76-81 GHz band. In return for access to this spectrum, the auto industry will vacate other bands, such as 16.2-17.7 GHz and 22-29 GHz, over time. Moreover, this action is consistent with efforts to globally harmonize spectrum for vehicular radar operations in the 76-81 GHz band. For this reason, I will vote for the item.

While long range radars have been operating in one gigahertz of spectrum at 76-77 GHz, a case has been made that short-range radars need four gigahertz of spectrum to provide the necessary higher resolution to detect and identify objects at close range. The practical functions of these radars include blind spot detection, lane change assist, collision warnings, autonomous braking, and the detection of pedestrians and bicycles.[1]

When I hear of these benefits, I get an odd sense of déjà vu. Several of these safety solutions are exactly the same or similar to those championed as reasons for DSRC. As I have said before, it is necessary to determine exactly what safety systems will be provided using DSRC and whether they can be provided using other technologies, including the very technology we consider today. Dedicated DSRC spectrum should not be used to provide safety functionalities – or any services for that matter – that can be offered using radars and other technologies being used or in the planning stages as we generally move towards more autonomous cars.

Limiting use of the 5.9 GHz spectrum for only safety solutions that cannot be otherwise provided elsewhere would ensure that, at a minimum, unlicensed users can share spectrum with DSRC without causing harmful interference. We may even find that the purported benefits of DSRC no longer hold up, but that will have to be a discussion for another day.

[1] *See supra* para. 3 & n.8.